A WORKLOAD INVENTORY FOR SOUTH AFRICAN ORGANISATIONS

by

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Concept Declaration

I, Tania Erika Myburgh declare that "A Workload Inventory for South African Organisations" is my own work. All the resources used in this study are cited and referenced in accordance with a comprehensive referencing system.

I declare that the content of this research has never been submitted for any other qualification at a tertiary institution.

Mrs. T.E. Myburgh DATE

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This dissertation would not have been possible without the guidance of my creator and the love and support of my colleagues, family and husband.

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Abstract

Current literature reflects escalating concerns regarding the potential organisational damage that can result from overloaded and under loaded workforces. Overloaded and under loaded workforces have been linked to poor employee well-being, reduced productivity, dissatisfaction and higher turnover rates. This study aimed to develop a scale for the measurement of workload within South African organisations. The initial scale contained six dimensions and a total of 71 items. These items were then sent to subject matter experts in order to determine their content validity. The survey was then completed by 224 employed individuals. An exploratory factor analysis (EFA) was performed and six factors were indicated. The overall reliability of the scale was highly satisfactory with inter-correlations between scale items. The results suggest that the South African Workload Scale (SAWS) is a promising instrument for the measurement of workload within South African organisations.

Opsomming

Toenemende kommer bestaan oor die oorlading sowel as onderlading van die werkskorps, aangesien die werkslading potensiele skade inhou vir organisasies, meer spesifiek werknemers se welstand, verlaagde produktiwiteitsvlakke, ongelukigheid met werk en verlies van waardevolle werknemers. Die oorhoofse doel van die studie is die ontwikkeling van ‘n skaal vir die meting van werkslading vir Suid-Afrikaanse organisasies. Die oorspronklike skaal het bestaan uit ses dimensies met ‘n total van 71 items; hierdie items was geevalueer deur vak gebied kundiges om die inhoudsgeldigheid daarvan te bepaal. Die vraelys was toe voltooi deur 224 werkende individue. Die betroubaarheid van die skaal was hoogs aanvaarbaar met inter-korrelasies tussen die skale se items. Die resultate stel voor dat die Suid-Afrikaanse Werkslading Skaal (SAWS) ‘n goeie meetinstrument is vir die bepaling van werkslading in Suid-Afrikaanse organisasies.

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CHAPTER 1

Contextualisation of the study

"Research is formalised curiosity. It is poking and prying with a purpose"

Zor Neale Huston, 1903-1960

1.1 INTRODUCTION

1.1.1 Background

Increasing workload, long working hours and pressure to accomplish more tasks and duties with less manpower are negatively impacting employees, organisational effectiveness and ultimately organisational success. There is an escalating concern that an overloaded workforce is potentially damaging to organisations in terms of poor employee well-being, reduced productivity, dissatisfaction and higher turnover rates. Many organisations remain ignorant of the vast volumes of work their employees are required to manage. These organisations only become aware of this difficulty when their employees experience burnout, stress and fatigue. Furthermore, even when organisations are aware of an overloaded or under loaded workforce they do not know how to address the problem.

Hart (2008) defines workload as the expenses of accomplishment of mission requirements for the employee to carry out his or her work. However, this definition is vague and does not contribute to the measurement of workload. The National Aeronautics and Space Administration – Task Load Index (NASA-TLX) often used to measure workload. This measurement instrument includes six subscales, labelled: mental demands, physical demands, temporal demands, frustration, effort and performance. Overall workload thus consists of a combination of these six component dimensions (Hart 2008). It is vital that organisations realise the importance of workload within the organisational systems. To ensure the health and safety and effective performance and productivity of employees, organisations must develop realistic goals for specific work tasks in order to ensure that

employees are not under loaded or overloaded (Rubio, Diaz, Martin, & Puente, 2004). When organisations realise the value of addressing workload imbalances they can move forward in terms of assessing the employees' current workload and determining realistic goals for specific tasks. Increased workload can increase errors within the work environment and compromise employee safety (Young, Zavelina, & Hooper, 2008).

The evaluation of mental workload is currently receiving a lot of research attention. This research aims to increase satisfaction, efficiency and safety in the workplace (Rubio et al., 2004). Several researchers (Hart, 2008; Hart & Staveland, 1988; Luximon & Goonetilleke, 1998; Rubio et al., 2004) have developed instruments to measure workload, but no such instrument has been developed for use within the South African context. An extensive of academic databases failed to uncover any previous research related to the development of a workload measurement instrument for use within South African organisations. Workload's potential to influence stress, fatigue, boredom, turnover and various other organisational factors makes it extremely important for organisations in South Africa to have access to a valid and reliable instrument to measure workload. This study is thus important from a practitioner and an academic standpoint.

Previous research regarding subjective workload assessment has confirmed the necessity of developing a scale that measures workload for the diverse South African population. Recent literature has focused specifically on mental workload. Studies include that of Miyake (2001), which attempted to standardise a workload measurement process for mental workload. Bunce and Sisa (2002) investigated age differences in the workload associated with the completion of a demanding task. A review of recent research utilising workload instruments shows that some instruments are widely used and have been translated into numerous languages. These instruments are administered verbally, in writing or electronically and have been used in various countries (Hart, 2008; Hart & Staveland, 1988; Luximon & Goonetilleke, 1998; Rubio et al., 2004). To date no workload instrument has been developed for use within the South African organisation context. The development of a valid workload measure for the South African organisational context is critical for the development of knowledge regarding workload measurements and for the evaluation of assessments.

The validity of internationally developed subjective workload measurements is limited. The lack of research regarding subjective workloads in the South African context indicates a clear need for empirical research in this regard (Braarud, 2001). This study also makes a practical contribution as the assessment tool developed in this study can also be used for diagnostic purposes. It is hoped that the data collected in this study will inform the content and focus of future of workload measurement within the South African organisational context.

1.1.2 Problem statement

Although various workload inventories exist (Hart, 2008; Hart & Staveland, 1988; Luximon & Goonetilleke, 1998; Rubio et al., 2004) none of these inventories was developed for use with a South African population. The instruments available are ipsative and make statistical measurement and analysis difficult. The previous studies regarding workload are therefore unsatisfactory and a need exists for the development of a scientifically satisfactory workload inventory. Twenty-first century work organisations and employers have much to gain from the development of a scale that is valid for use within the South African context.

1.1.3 Purpose statement

The main purpose of this study was to develop a scale for the measurement of workload in the South African organisational context. The study generated the items for measuring workload and assessed the validity of the items.

1.1.4 Research objectives

One of the objectives of the research was to determine, by means of a comprehensive literature review, the definitions of workload and the meanings of workload within the South African organisation. These definitions and meanings were used to compile a comprehensive framework that formed the basis of the workload scale development process.

The primary objective of the research therefore was to develop a workload measure based on the framework established. The research aimed to:

- Develop a scale that measures all the facets of workload;
- Generate items that measure workload in the South African organisation.

The secondary objective of the study was to enhance, the understanding of the concept of workload and the factors that constitute the scope of workload within South African organisations.

1.1.5 Importance and benefits of the proposed study

The literature recommends that future research explore the nature and complexity of the construct workload, as current definitions fail to reflect the richness of the construct. This study investigated workload in order to determine the nature and content of the construct and developed a scale for the measurement of workload.

Previous studies have focused on a single dimension of mental workload and fail to produce empirical data (Miyake, 2001; Bruce & Sisa, 2002). The development of a scale for the measurement of workload contributes towards the production on empirical data regarding the construct.

Literature regarding workload measurements shows that some instruments are widely used and have been translated into numerous languages, administered in various formats and in various countries (Hart, 2008; Hart & Staveland, 1988; Luximon & Goonetilleke, 1998; Rubio et al., 2004). The lack of a workload measurement for use in the South African organisational context served as the backdrop for this study. This study therefore makes a significant contribution to the existing body of knowledge.

This study makes a valuable contribution to research as it was conducted in the South African context. The findings of the research assist South African organisations and employers in determining their employees' workload. The scale that was developed is not

industry specific but it is specifically applicable to the South African context. The results of this study expand the existing body of knowledge and serve as a valuable contribution to the research base regarding workload in the world of work.

In order to manage reader expectations, the research objectives, specification of unit of analysis and demarcation of the study are discussed in the next section. The literature was synthesised with the aim of developing an integrated theoretical framework that served as the foundation for the development of a scale for measuring workload.

1.2 DELIMITATIONS AND ASSUMPTIONS

1.2.1 Delimitations

The study has several delimitations related to its context, constructs and theoretical perspectives. Firstly, the study was limited to the South African organisation, specifically employed individuals. As such, individuals from other countries and unemployed individuals were excluded.
Secondly the study focused on specific facets of workload, referred to as mental demand, physical demand, temporal demand, performance, effort and frustration. The study's focus on developing a workload inventory for use within the South African organisation means that other workload measures were not a focus point.

Lastly, the literature review was primarily limited to literature from the social sciences. Literature from other disciplines was only briefly considered.

1.2.2 Assumptions

Several basic assumptions underlie this research study. These assumptions are listed below.

- All employees within an organisation have a workload, and this workload can be manageable, overload or under load.
- Workload is a recognisable phenomenon within an organisation.

- Workload can take a variety of forms. For the purposes of this study it is limited to mental demand, physical demand, temporal demand, performance, effort and frustration.
- Employees can recognise and/or acknowledge their level of workload.
- Quantitative research is a suitable method for the analysis of workload.
- Subjects completed the questionnaire honestly.
- The statistical packages consulted in the study are appropriate and sufficient for the purposes of the study.
- The sample is sufficient and representative of the South African population.
- Previous studies regarding workload were conducted in a professional and ethical manner.

1.3 OVERVIEW OF THIS STUDY

The presentation of this dissertation is designed to allow a logical presentation of the researcher's arguments. The dissertation begins by defining the problem and ends by proposing possible solutions based on scientific research methods.

Chapter one serves as an introduction to the background of the research problem. The research objectives, significance, framework and focus of the research study are also included.

Chapter two presents the findings of the literature review. The literature review focuses on attaining a comprehensive definition of workload. The chapter also reviews previous workload measurements in order to gain an in depth understanding of the available measures and their validity and reliability. Different workload models are reviewed. Figure 1.1, provides a schematic representation of the contextual framework of the literature study.

Figure 1.1 The scope of the research

Chapter three discusses the researched methodology and the research method. The rationale for the methodology used is provided. This rationale is based on the literature review in conjunction with previous research. The chapter also describes the research method and the way in which the study was conducted.

The results, findings and statistical analysis are presented in chapter four. The chapter discusses the application of analysis tools and provides a comprehensive display of the analysis and results.

Chapter five discusses the main findings in terms of the research objectives. This chapter also includes the conclusion, limitations and recommendations.

CHAPTER 2

Literature Study

"A great literature is chiefly the product of inquiring minds in revolt against the immovable certainties of the nation"

H.L. Mencken

2.1 INTRODUCTION

This chapter contains a discussion of the existing literature concerning workload. The focus is on the various aspects that constitute the workload construct. These aspects were used for the development of the workload inventory described in following chapters. The literature study includes the following areas in relation to the research problem and objectives set out in chapter 1.

- Workload as a key concept
- Workload and human operator states
- Workload theories and frameworks
- An operational definition of workload
- Workload measurement techniques
- Psychometrical constructs

Figure 2.1 provides a visual representation of the depth and scope of the literature review concerning workload.

Figure 2.1 The scope of the research

2.1.1 Definition and description of workload

The definitions in this section are taken from various research articles and are used to define the key concepts and clarify their meanings for the purposes of this study. The workload factors that are addressed in this section are related to workload's association with human operator states and various variables that have an impact on workload. These research findings must be viewed within the context of human resource management and the social sciences.

2.1.1.1 Workload as a key concept.

Although a great deal of research has focused on workload and its underlying factors the construct remains difficult to define. There is no distinct, generally accepted definition of workload, but there are several conflicting understandings of the concept. In addition, some studies use the term workload without providing a proper definition. This section therefore aims to provide an operational definition of workload that is grounded in literature. Moray (1979) traces the theoretical development of the construct of workload to a NATO conference of 1970 and the published text of that conference. The practical

significance of workload was established several decades ago during the exploration of human-machine systems such as ground transportation, air traffic control and process (Moray, 1979). Parasuraman and Hancock (2001) have focused on the theoretical underpinnings, assessment techniques and real-world repercussions of workload in a range of work spheres. Differences exist regarding the definition of workload. Huey and Wickens (1993) state that the term workload was not commonly used before the 1970s. Numerous academic and non-academic theorists disagree about the sources, mechanisms, consequences and measurements of workload (Huey & Wickens, 1993). These differences are understandable because the nature of workload differs according to environment. For example, a computerised work environment workload is mostly cognitive while a training and fitness environment workload is mostly physical. This suggests that the nature of the work and the work environment must be considered when making statements regarding workload.

2.1.1.2 Workload as a function of demand and supply.

Workload is generally defined as the extent of the processing capacity that is expended during the performance of a task and thus involves the interaction between resource supply and task demand (Young et al., 2008). DiDomenico and Nassbaum (2008) support this definition and state that workload is determined by the relationship between task demands, the circumstances under which that task takes place and the perceptions, actions, skills and knowledge of the individual performing the task. The task demands may include physical actions, cognitive tasks and/or a variety of other factors. These definitions suggest that workload is concerned with the relationship between the task demand and the person's resources, which include skills, knowledge, behaviour and task perception (Young et al., 2008; DiDominico & Nussbaum, 2008).

Workload can also be defined as the expenditure incurred by a person, given their capacities (resources), while achieving a particular level of performance on a particular task with certain demands (Hart & Staveland, 1988). Hart and Staveland (1988) categorise demands as follows:

- *Mental Demand:* The amount of perceptual and mental activity required for a task. Mental demand includes activities such as judgment, thinking, deciding and

calculating and can be determined by asking whether the task was uncomplicated, challenging, simple or complex and tough or lenient.

- *Physical Demand:* The amount of physical activity necessary to complete a task, which includes pulling, pushing, controlling, regulation and activating. Questions related to physical demand usually look at whether the task was easy or challenging, slow or hurried, slack or tiring and restful or laborious.
- *Temporal Demand:* This demand describes the time pressure experienced due to the pace (unhurried or rapid) and rate of the task.
- *Performance:* This demand relates to an individual's subjective assessment of his/her success in terms of the task set. It evaluates whether or not an individual believes they have met the task goals.
- *Effort:* This demand relates to the amount of work (mental and physical) that was required in order to perform at the desired level and achieve the goals.
- *Frustration Level:* Relates to an individual's feelings of annoyance, discouragement, self-doubt, stress, satisfaction, gratification, protection, relaxation and complacence in relation to the task,

These demands are essential in the construction of the total workload construct. The workload inventory developed in this study must consider these demands and make an informative and accurate analysis of overall workload in the workplace.

Within the work environment workload is significant when it is experienced as either excessive (overload) or insufficient (under load). Work overload occurs when task demands exceed the capacity and resources of the person. This means that the operator attempts to use his/her experience, knowledge and skills to complete the task but they are insufficient for the task at hand. According to Young et al. (2008) work overload results in consequences such as fatigue, absenteeism, high turnover rates, increased accidents and decreased commitment to an organisation. These consequences can all be extremely costly to an organisation. Work under load is also of concern to organisations as it results in boredom and decreased productivity and efficiency. Workload is thus important to South African organisations because they desire effective, healthy, happy and efficient workforces, and this can only be attained when employees' workloads are manageable. .

Various researchers have compared the concept of workload to a variety of economical concepts and organisational behaviour (Braarud, 2001; Dickinson, Byblow, & Ryan, 1993; Young et al., 2008). These concepts include fatigue in the workplace (Young et al., 2008), complex team tasks (Braarud, 2001) and process control (Dickinson et al., 1993). Numerous studies have focused on the relationship between mental workload and organisational behaviour (Hart, 2008: Hart & Straveland, 1998; Luximen & Goonetilleke, 1998; Rubio et al., 2004). These studies are relevant in that their findings served as a guide for the current study. This study investigated the existence of any correlations between the findings of previous studies and its own findings.

2.1.1.3 Defining workload as a function of capacity.

Workload is often defined in terms of its association or interaction with other concepts. Workload has thus been conceptualised in terms of the interaction between the task demands and the capacity of the human operator. O'Donnell and Eggemeier (1986) define workload with reference to the amount of capacity used, specifically the human operator's limited capacity required to perform a specific task. Reinach (2001) states that task demand is determined by the goal that must be attained by performing the task. Workload is thus conceptualised in terms of the operator's skills, training and ability in relation to the goal to be achieved in performing the task.

Senders (1979) argues that as task increase in complexity more mechanisms are involved in achieving the task demands and this results in an increase in the use of capacity. Capacity is thus not a constant but a changeable concept. The human operator can develop skills and can go for training to be more capable of performing a specific task. For example, operator A has recently started working at Organisation X and has limited skills in that particular position, while operator B has been working at Organisation X for an extended period of time and has extensive skills in that the same position. Operator B will therefore experience a different workload than operator A in performing that particular position's tasks. In addition, the operator's willingness to exert capacity may also play a role in the amount of effort he/she is willing to exert on the particular task (Moray, 1979). This implies that although operators may have the necessary skills to perform a task they may lack motivation or interest.

Parasuraman and Hancock (2001) emphasise the importance of considering mediating factors in relation to workload, instead of simply assuming that workload is a reflection of the relationship between the environmental demands imposed on the human operator and the operator's capacity to address those demands. Workload is not only driven by environmental demands but also the individual human operators' responses, skills and training level, task management, strategies and various personal characteristics (Parasuraman & Hancock, 2001). In practice the operators' workload may only be experienced as an over- or under load because of the operators' characteristics and personal motivation.

2.1.1.4 Workload defined as an experienced load.

Workload consists of more than the demand placed on the human operator. Instead, workload can be attributed to more than merely an external source and can be defined according to the operators' experienced load. The concept of experienced load shifts the emphasis from a task-specific to a more person-specific definition of workload. Kruger (2005) arguments that the operator's capabilities, motivation, task strategies and mood have an effect on the experienced load. Workload is thus dependent on the human operator and, because of the interaction between the operator and the task structure; the same demands do not result in an equal level of workload for all operators (De Waard, 1996).

Workload can also be defined as the cost incurred by a human operator to achieve a specific level of performance. Hart and Staveland (1988) state that workload involves the operator's subjective experience of workload and is thus a product of the interaction between the requirements of a task, the circumstances under which a task is performed and the perceptions, skills and behaviours of the operators.

Meister (1985) describes workload as a multidimensional concept that can be defined in terms of input, output and consequence. When defined as an input workload represents the stimuli load. When workload is defined as an output it is seen in terms of a systems approach that views workload as affecting the operator's performance, which in turn

affects the organisation as a system. Meister (1985) also describes workload in terms of the operators' internal experience of the level of difficulty and complexity, their personal recognition that they are indeed experiencing a load and the strategies that they apply to manage the workload.

This section suggests that workload is not simply the capacity to respond to the task demands but also involves the human operators' subjective experiences of work.

2.1.1.5 Workload defined in terms of the time load.

Reid and Nygren (1988) define workload as a multidimensional concept that consists of three component factors: time-load, mental effort load and psychological stress load. Meister (1971) also defines workload in relation to time and states that there is a correlation between limited capacity and competition. This occurs because tasks have to be completed in a certain amount of time and the human operator only has a certain amount of time available for a particular task (Meister, 1971). The operator also only has a certain amount of capacity (attention span). Workload is thus a product of the conflict between the operator's capacity and the time available for the specific task.

Time load is defined as the time available for the particular task and the task overlap. Reid and Nygren (1988) state that a time-load problem occurs when the time available for a specific task is exceeded by the time required for the task. Effort load is then defined in terms of the operator's capacity (Reid & Nygren, 1988). In other words, when an operator uses some resources for a specific task and uses other resources for a different task this means that some some resources are held in reserve and some resources are used. Operators may thus be required to expend additional effort in order to complete the task (Reid & Nygren, 1988). The last component of Reid and Nygren's (1988) model relates to individual operator factors such as motivation, training, fatigue, health and emotional state. These factors are labelled psychological stress load (Reid & Nygren, 1988).

2.1.1.6 Workload task variables.

A vast amount of literature places emphasis on the measured indicators of workload. However, the nature of the task and its environment also pay an important role in understanding workload. Meshkhati (1988) states that in order to understand a task an understanding of task criticality, environmental factors, amount of information, time response, task structure, task complexity, equipment and design and task novelty is required (see figure 2.2.). The variables were initially utilised in the military aviation sector and only variables that are relevant to this study are discussed in the section below.

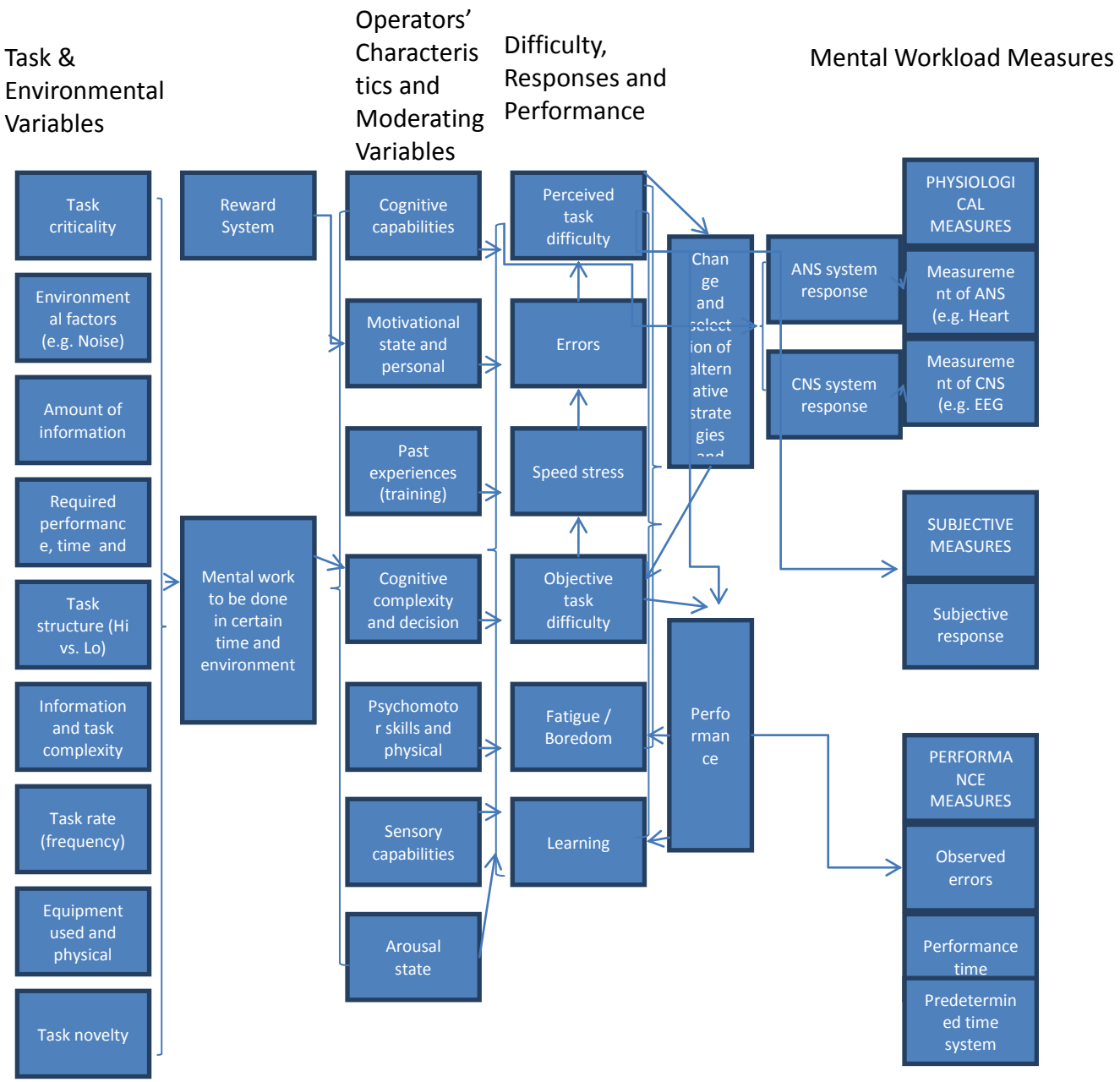

Figure 2.2. Measured Indicators of Workload. Note: From *A systems approach to the assessment of mental workload in a safety-critical environment,* p. 45 by A. Kruger (2005). Pretoria: University of Pretoria.

2.1.1.6.1 Task criticality.

Meshkati (1988) define task criticality as a function of the task content and the impact of the execution or non-execution on the task itself. The criticality is of importance in terms of the potential impact of the execution or non-execution as well as the operators experience thereof.

2.1.1.6.2 Environmental factors.

Environmental conditions can potentially influence an operator's perception of the workload. The ergonomics of the work environment is of importance and includes factors such as noise, seating adequacy, temperature and environmentally specific factors (Cilliers, 1992).

2.1.1.6.3 Amount of information and complexity.

The quantity of information an operator is required to digest combined with the difficulties imposed by the particular task can influence the operator's workload (Cilliers, 1992). For example, a soldier's tasks are structured and predictable when normal operations are in place but when an emergency situation takes place the amount of information that must be processed is excessive and difficult and may lead to errors.

2.1.1.6.4 Task structure.

Cilliers (1992) defines task structure as a function of the design in the interface between the machine/task and the operator. In work environments where the task structure is high the tasks may be highly structured and based on set procedures (Kruger, 2005).

2.1.1.6.5 Equipment and design.

Each operator can be exposed to a different spectrum of ergonomics such as the adjustability of work stations and chairs, noise, temperature and the state and condition of equipment utilised (Kruger, 2005). The impact is that every operator experiences the ergonomics and equipment differently.

2.1.1.6.6 Time response.

Kruger (2005) states that the time available for task execution is an important factor in determining workload. A distinction should be made between routine tasks and tasks executed during emergency conditions. During emergencies the time available is a function of the number of emergencies (Kruger, 2005).

2.1.1.6.7 Other factors.

Meshkati (1988) also includes the operator's state of arousal, sensory competence and level and amount of training and experience as significant factors impacting his/her perception of workload.

2.2 WORKLOAD AND HUMAN OPERATOR STATES

Within this study workload is considered to be a holistic concept and it is therefore imperative to understand and comprehend the impact of workload on the operator. The understanding of the impact of workload on the operator's state complements the purpose of this study and is important in the development of a measure of workload.

Clearly distinguishing between operator states is important for theory building but also has a significant impact on the restructuring of the work environment in the twenty first century (Gaillard, 2001). Many organisations employees experience stress, fatigue and boredom as a result of their daily tasks. It is important that these experiences be defined in terms of the workload construct.

2.2.1 Workload, stress and boredom

Stress has become the focus of much organisational research and is often linked specifically to the rapid pace of most modern organisations. Gaillard (2001) defines stress as:

- *An input variable:* Work demands (difficulty and time pressure), emotional threat (accidents, errors) or adverse environments (noise, physical environment).
- *An output variable:* A sequence of behavioural, subjective and physiological responses.
- *A state:* The human operator experiences a feeling of strain, pressure and threat based on a subjective evaluation.
- *A process:* A gradual sequence resulting in a dysfunctional state, decreasing the operator's works capacity and ability to recuperate from work.

Stress is also defined as a relationship between the individual and his/her environment. Stress occurs when an individual views the environment as exceeding his/her capacity and endangering his/her well-being (Hancock & Desmond, 2001). Boredom is defined as feelings of increased constraint, repetitiveness and unpleasantness and decreased arousal (Hancock & Desmond, 2001). Hart and Bortlussi (1984) define workload as the change in effort when managing tasks, while stress is defined as an experience that result from changes in the tasks.

This suggests that employees require stimuli from a variety of tasks to avoid boredom. The type of stimuli required varies for each operator and some operators require task variety while others prefer repetitive tasks.

Attempts to manage stress at work often focus on stress prevention through early diagnosis and intervention rather than on providing employees with coping skills to manage stress. In order to decrease the stress levels in an organisation the following questions need to be addressed:

- What is the current level of stress in the workplace?

- What is the result of stress on the functioning of the organisation?
- What are stressors? (Hancock & Desmond, 2001).

These questions can be addressed by conducting a stress audit. Stress is important within the context of this study as the constructs of workload and stress are closely related.

2.2.2 Sources of stress

Every job contains possible environmental sources of stress (Hancock & Desmond, 2001). These sources of stress include factors such as the job tasks and the work environment. Specific physical conditions such as noise, weather and working hours may contribute to stress. These conditions may also contribute to an operator's perception of workload. For example, an operator working in a factory that has high noise levels throughout the working day may perceive the workload as an overload based on the noise level rather than the actual tasks. Sources of stress can contribute to the workload dimensions discussed below.

- *Work overload and under load*

Work overload is usually related to an employee either having too much work or the work being too difficult. This overload results in long working hours that result in the employee experiencing physical and psychological health problems (Hancock & Desmond, 2001). Work under load on the other hand is generally associated with too little work, resulting in employees experiencing boredom.

- *Repetitive and under stimulating work*

According to Hancock & Desmond (2001) jobs with minimal opportunity for control and personal influence are mostly likely to be affected by stress. This means that individuals who conduct repetitive tasks without any decision making (e.g. counting boxes) are most likely to experience stress.

Stress and workload should be viewed as too separate constructs that are closely related but not identical. Stress is the result of subjective experience relating to the human

operators' loads. Wefald, Smith, Savastano and Downey (2008) provide an explanation for the relationship between workload and stress, which is illustrated in figure 2.3.

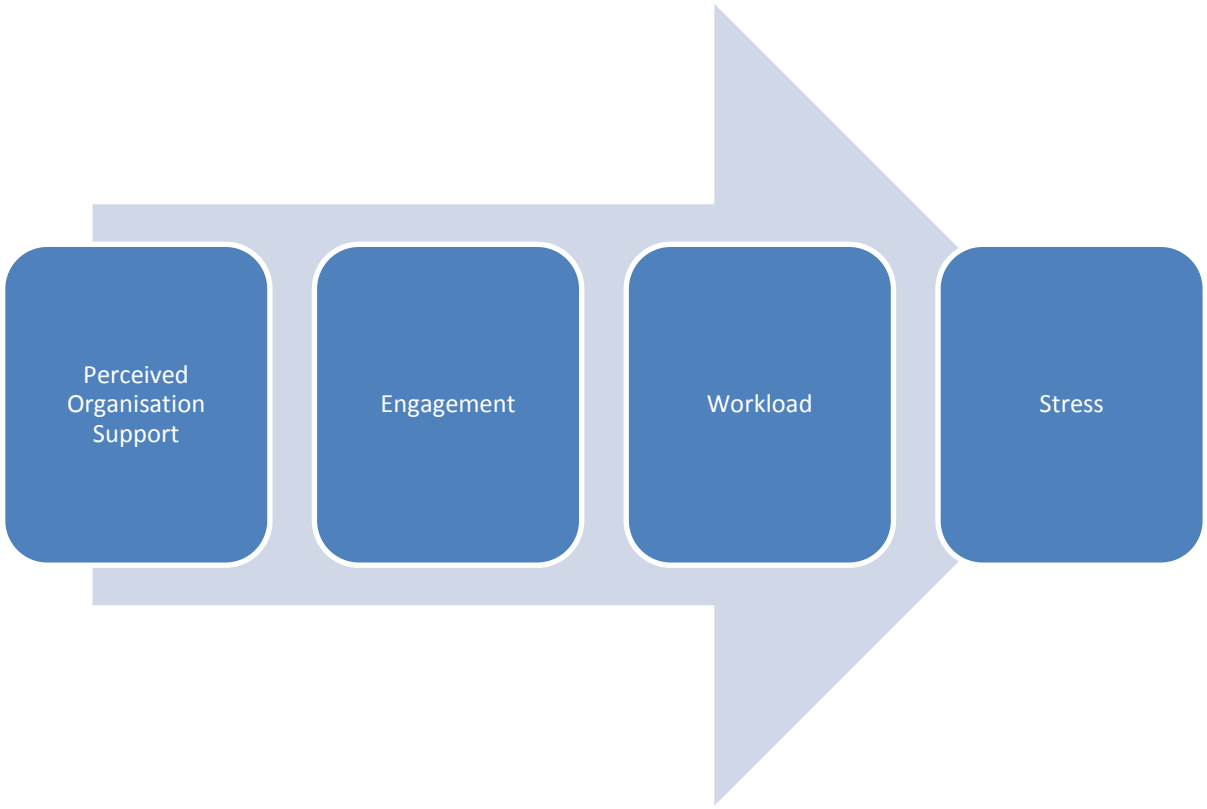

Figure 2.3. Model of workload, job attitudes, stress and turnover intentions

Note: Adapted from *A structural model of workload, job attitude, stress, and turnover intentions.* by A.J. Wefald, M. R. Smith, T.C. Savastano and R.G. Downey (2008) Pretoria: University of Pretoria.

2.2.3 Workload and fatigue

Fatigue is a physical and cognitive response to a reduction in resources due to the execution of a task/ tasks (Gaillard, 2001). Fatigue can also be defined as a general feeling of lack of energy that may or may not be related to the execution of tasks (Gaillard, 2001). Workload fatigue is thus the result of the task demand exceeding the operator's capacity or the time period for completion. Desmond and Hancock (2001) differentiate between active fatigue and passive fatigue. Active fatigue is the outcome of continuous and prolonged task-related, perceptual-motor adjustment. In contrast, passive fatigue refers to a system monitoring rare or very limited overt perceptual-motor response

requirements and develops over a period of time (Desmond & Hancock, 2001). This reinforces the importance of time in determining workload.

2.3 WORKLOAD THEORIES

In order to fully grasp the concept of workload it is essential to review the relevant theories. In this section the relevant theories are reviewed and discussed in terms of their significance for the development of a workload measure.

2.3.1 Theoretical concepts

De Waard (1996) states that the concept of capacity is related to workload and is defined differently by different authors (Kahneman 1973; Wickens 1984). Kahneman (1973) refers to workload as a single capacity from which resources can be drawn for the execution of responsibilities. O'Donnell and Eggemeier (1986) use the terms capacity and resources interchangeably. In contrast, Wickens (1992) differentiates between capacity (maximum processing capability) and resources (mental effort). The relationship between the allocation of resources and the performance of tasks remains linear until all resources are invested (DeWaard, 1996). In the 1980s Wickens (1984) suggested a multi-resource theory that indicates that auditory and visual resources are the most prominent central resources for the performance of all tasks. Tasks therefore require the performance of two auditory tasks and use the operator's full auditory capacity, thus affecting the performance of both tasks (De Waard, 1996). It is evident that a relationship exist between workload, capacity and resources and that these factors all influence performance.

2.3.2 Workload models

The applicability of the majority of predictive workload models is very limited because of the difficulties involved in gathering a comprehensive scenario of tasks and developing the parameters of the models (Xie & Salvendy, 2000). Models will have more practical value if they are developed on both a conceptual level and an operational level. The conceptual level refers to a model that is domain-independent, while the operational level refers to the

inclusion of a variety of situations (Xie & Salvendy, 2000). In other words there is a need for a model that applies to different domains and that includes situations from different working environments.

2.3.2.1 Xie and Salvendy's Framework for Workload Measures

Xie and Salvendy (2000) state that the majority of current workload measures only compute one facet or component of workload. Components measured by individual measures include overall workload, average workload and accumulated workload. However, in most measures no clear distinction is made between the different components. This results in vague and unclear frameworks. In order to clearly conceptualise workload a comprehensive model is needed as a frame of reference. Xie and Salvendy (2000) propose a framework that includes various types of workload measures such as instantaneous workload, peak workload, accumulated workload, average workload and overall workload.

Table 2.1 provides definitions for each of the components of Xie and Salvendy's (2000) workload components.

Table 2.1. Workload Framework Definitions

Workload Measures	**Description**
Instantaneous Workload	Dynamics of workload. Workload can be viewed as different from situation to situation, during different events.
Peak workload	The workload value of instantaneous workload (mental) during the performance of a task. Determined by comparing all instantaneous workloads. The significance lies in the fact that when the peak loads exceeds the human resources limit it

	results in degraded performance levels.
Accumulated workload	The total amount of workload that the employee experiences after the completion of a particular task. This measure indicates the total amount of information that has been processed during a particular task.
Average workload	The intensity of the workload within a specific time frame.
Overall Mental Workload	The mapping of instantaneous workload or accumulated and average workload in the employee's brain. This measure is assumed to correlate highly with accumulated and average workload

Note: From Prediction of Mental Workloads in Single and Multiple Task Environments, by B. Xie and G. Salvandy (200) *International Journal of Cognitive Ergonomics,* 4(3) p. 218.

The relationships between all five types of workload measures are illustrated in figure 2.4.

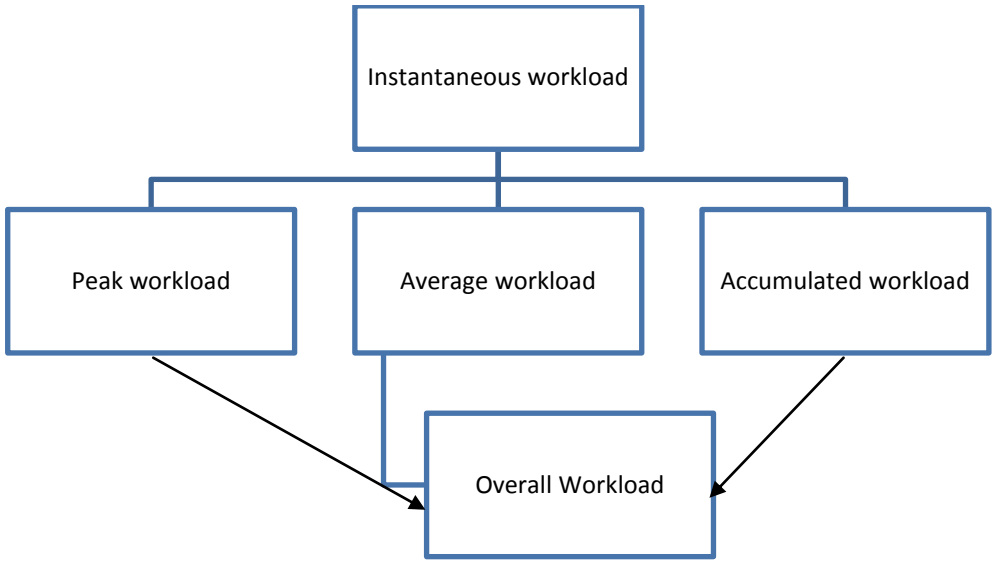

Figure 2.4. Conceptual Framework of Workload Types

Note: From Prediction of Mental Workloads in Single and Multiple Task Environments, by B. Xie and G. Salvandy (2000). *International Journal of Cognitive Ergonomics,* 4(3), p.219.

The framework outlined above can be extended through making workload framework task specific. Xie and Salvendy (2000) thus differentiate between effective and ineffective workload. Effective workload is the workload that employees must experience while working, even if they act efficiently and correctly. Effective workload thus refers to the minimum level of workload that is generated by the requirements of the tasks, regardless of the identity of the person who performs the task (Xie & Salvendy, 2000). In contrast, ineffective workload is workload that is generated as a result of the identity of the individual employee and can be reduced by incorporating learning and training. Ineffective workload can and should be avoided as it does does not directly contribute to the completion of a task. Individuals experience different levels of ineffective workload (Xie & Salvendy, 2000).

The framework developed by Xie and Salvendy (20000 include three information processing stages: information perception, decision/response selection and response execution. Information processing includes attention resources, working memory and long-term memory. These concepts are presented in the table below.

Table 2.2. Information Processing Stages

Stage	Effective Workload	Ineffective Workload:
Information perception	Enable employees to catch critical information using optimised strategy	Process whereby the employees check information
Information, decision, response and selection.	• Enables employees to select a response using optimised strategy • Enables employees to catch critical information using	Process whereby employees process extra information

	an optimised strategy	
Response execution	Fast and accurate actions	Inaccurate and erroneous actions

Note: From Prediction of Mental Workloads in Single and Multiple Task Environments, by B. Xie and G. Salvandy (2000). *International Journal of Cognitive Ergonomics,* 4(3), p.221.

Each stage in this framework is accompanied by a mental process that results in either effective or ineffective workload. For example, when an employee perceives information during a particular task she/he can either focus on the critical information (effective workload) or check each part of the information (ineffective workload).

Xie and Salvendy (2000) present the following figure to illustrate the framework as a whole.

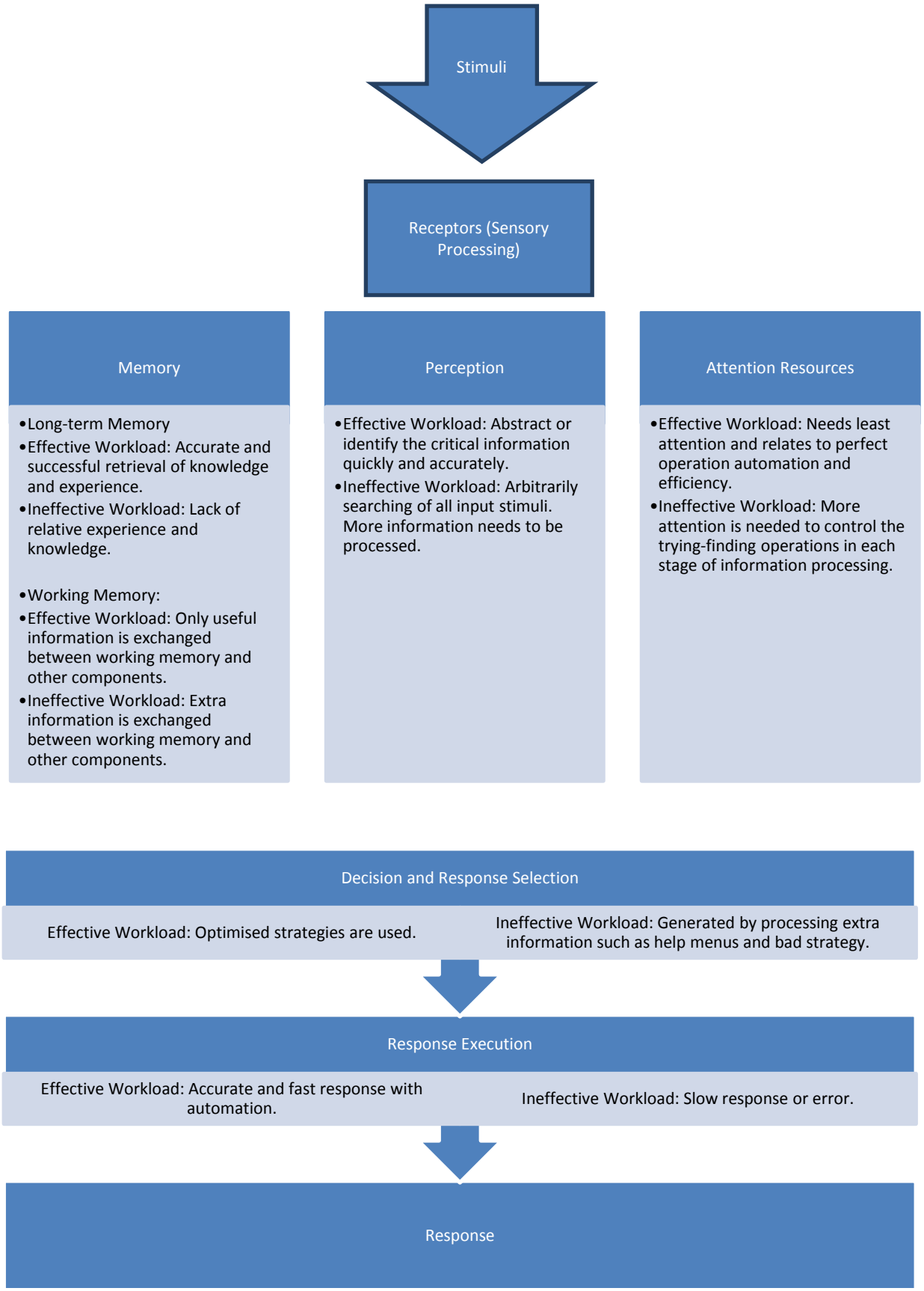

Figure 2.5. Workload Framework

Note: From Prediction of Mental Workloads in Single and Multiple Task Environments, by B. Xie and G. Salvandy (2000). *International Journal of Cognitive Ergonomics,* 4(3), p.221.

The framework presented by Xie and Salvendy (2000) is relevant and valuable to this study. The framework served as a source of items for the development of the workload measurement instrument. However, this framework has a clear focus on mental workload and the objective of this study was to develop a measure of overall workload. Thus only certain portions of this framework were relevant to the current study.

2.3.3 Hart and Stavelands' Workload Framework

Hart and Staveland (1988) describe workload as the expenditure incurred by a human operator in order to attain a certain level of performance. This definition of workload is thus human-centred. Workload is viewed as a result of the interaction between the requirements of a task, the specific circumstances under which the task is performed and the skills, behaviours, and perceptions of the employee (Hart & Staveland, 1988). Workload is thus a complex concept that refers to much more than simply the inherent nature of the task. Hart and Staveland (1988) propose a conceptual model of workload that includes sources and modifiers of workload. An explanation of the figure is provided below the figure.

Figure 2.6. Conceptual Framework for relating variables that influence human performance and workload.

Note: From "Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research" by S. G. Hartland and L. E. Staveland (1988) in P.A. Hancock & N. Meshkati (Eds), *Human Mental Workload*. p. 240. Amsterdam: North Holland Press.

Imposed workload refers to the situation encountered by the employee and includes task variables and incidental variables (Hart & Staveland, 1988). Task variables are determined by the objectives, duration and structure of the task and the human resources available in the specific situation. The actual strain may be transformed by the host factors (environment, system failures and operator errors) that are distinctive to the specific situation (Hart & Staveland, 1988). Incidental variables contribute to the workload's specific situation from one performance to the next.

Hart and Staveland (1988) define system response as consisting of behaviour and achievements. Employees are thus motivated by the imposed demands, but their behaviour also reflects their viewpoints and perceptions of what they should do as well as the strategies, effort and system resources required to perform the task objectives. Employees display both physical and mental effort. "Physical effort is the easiest to establish and measure whilst mental effort is difficult to quantify because it serves as the intervening variable among quantifiable stimuli and measurable responses" (Hart & Staveland, 1988, p. 241).

System performance is the product of the employees' actions, restrictions and capabilities and the features of the system (Hart & Staveland, 1988). Performance feedback provides employees with information about their success in meeting the specific task requirements, thus allowing them to utilize specific strategies and exert certain levels of effort to correct their own errors. Experienced workload and physiological consequences refer to the effect of the task on the employee. These factors are subjective experiences of workload and allow researchers to determine subjective ratings (Hart & Staveland, 1988).

Employees' experiences impact their behaviour and ultimately their performance and physiological responses (Hart & Staveland, 1988). When tasks are viewed as excessive employees behave as though they are overloaded and thus adopt strategies appropriate for a high-workload situation (minimizing tasks, responding quickly), experience psychological or physiological distress and adopt a lower criterion for performance (Hart & Staveland, 1988).

The framework provided by Hart and Staveland (1988) is appropriate for use within this study due to the following reasons:

- The framework follows a systems approach and views all aspects as interrelated and connected;
- All workload factors are included and there is not a focus on one type of workload as is the case with Xie and Salvendy's (2000) framework;
- Subjective measures and subjective ratings are the core of the framework and this subjective approach corresponds with the approach of this study.

This framework was thus used in the development of the workload measure used in this study and in the interpretation of the measure's results.

2.4 AN OPERATIONAL DEFINITION OF WORKLOAD

A vast quantity of information exists regarding the concept of workload and various paradigms and perspectives have generated varied definitions of workload. However, there is currently no consensus regarding the definition of workload. Moray's (1979) work established a grounded foundation but no further breakthroughs have been made. The concept of workload must therefore be closely examined. Kruger (2005) provides two reasons for the importance of achieving a deeper understanding of workload.

- Theoretically research needs to understand the relationships between workload and other constructs/
- Twenty-first century organisations want to be able to manage employees' workloads, ensuring that the load is manageable, yet challenging.

2.4.1 Synthesis of definitions

The numerous definitions of workload provided above allow for the construction of a synthesised definition of workload, which is presented in the figure below.

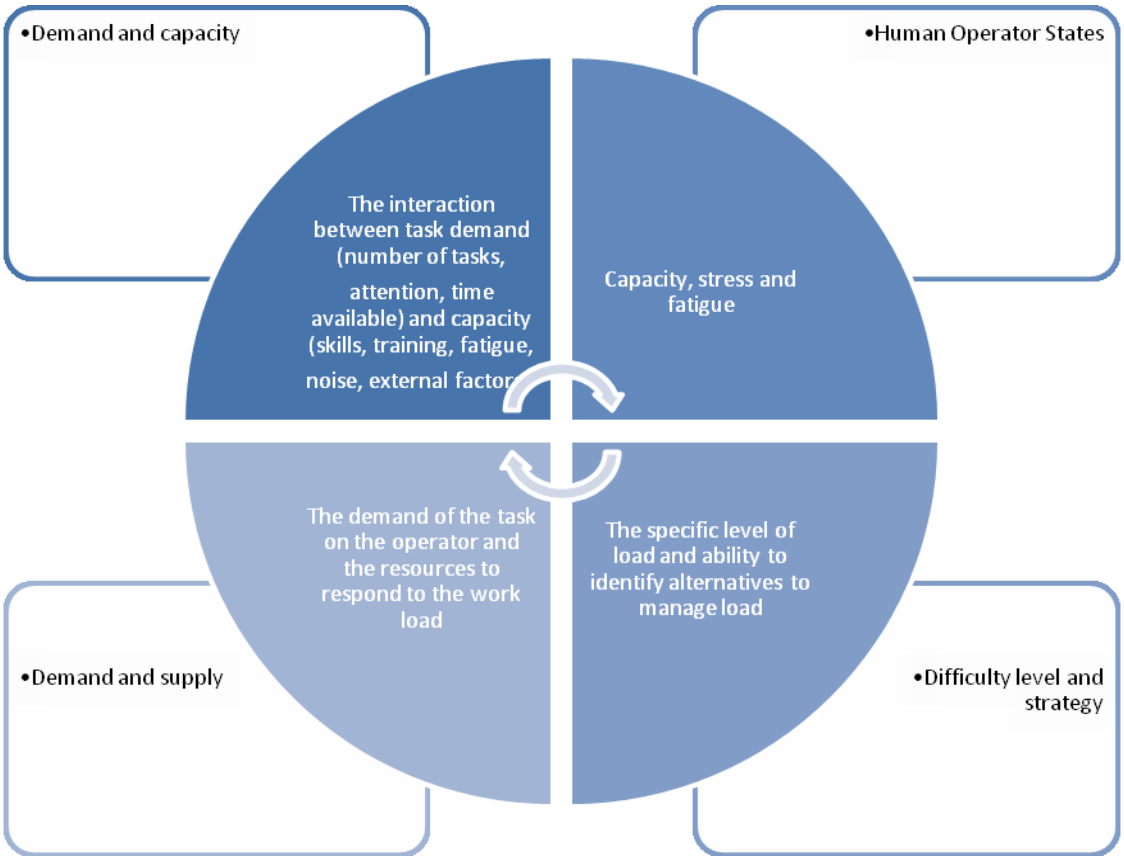

Figure 2.7. An Operational Definition of Workload

The development of a workload measures also involves consideration of the various workload models. Figure 2.8 sets out the prevailing factors that were considered during the development of the measure.

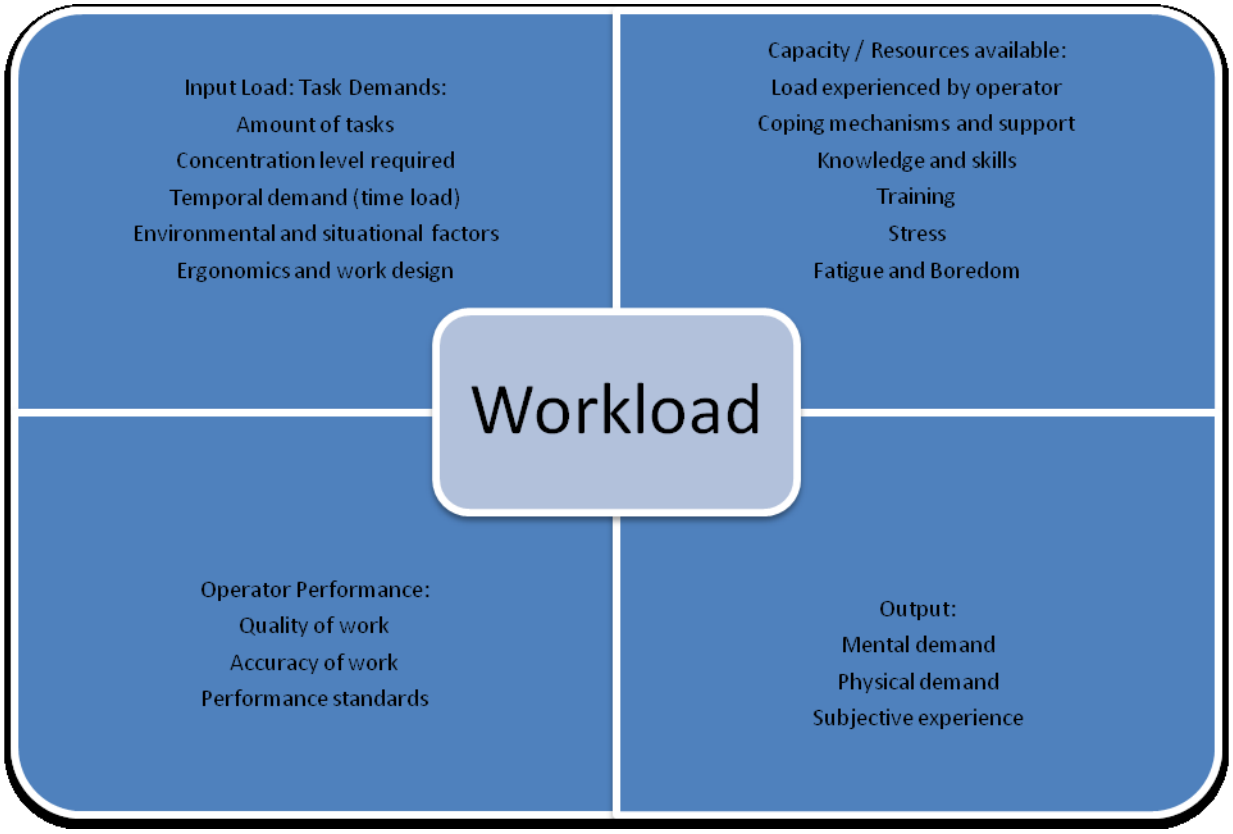

Figure 2.8. Workload Development Factors

Note: From *A systems approach to the assessment of mental workload in a safety-critical environment,* p. 37 by A. Kruger (2005). Pretoria: University of Pretoria.

2.5 WORKLOAD MEASUREMENT TECHNIQUES

In this section the strengths and weaknesses of the most commonly used existing workload assessment techniques are discussed. The criteria for the selection of workload assessment techniques are also presented.

Measurement techniques are commonly divided into three subsections:

- Primary task performance measures;
- Secondary measures;
- Subjective rating techniques (Farmer & Brownson, 2003).

Each assessment tool was critically evaluated prior to the study in order to determine its applicability for use in the study.

2.5.1 An overview of workload measurement techniques

Moray (1979) states that the theoretical development of the concept of workload can be traced back to the NATO conference in 1970 and its specific reference to mental workload. Since this initial conceptualisation numerous studies have been conducted focusing on the underlying theory, assessment techniques and the impact of workload on a diversity of work sectors (Parasuraman & Hancock, 2001). The bulk of research was conducted in the in the 1970s and 1980s (Kruger, 2005). During this time workload became conceptualised as a multidimensional construct (Kruger, 2005). This conceptualisation necessitated the development of multiple workload measures.

The two most widely accepted and utilised workload measurements were developed in the 1970s and 1980s. These measures are referred to as the Subjective Workload Assessment Technique (SWAT) and the National Aeronautical and Space Administration Task Load Index (NASA-TLX) (Kruger, 2005). These tools are considered to be effective in the subjective measurement of workload and have been used primarily within the military, aviation and aeronautical industries. These measures are effective n measuring the subjective experience of workload but fail to take into account operator factors such as stress, fatigue, boredom and absenteeism. These factors are critical in the twenty-first century workplace and form a crucial part of this study.

Wickens and Hollands (2000) indicate that the workloads experienced by human operators are assessed for the purpose of selecting operators or providing training to operators. Kruger (2005) suggests that workload tools should be used in three different contexts: workload prediction, physical workload assessment and experienced workload assessment.

Meshkati (1988) presents a comprehensive model that accounts for all the different workload measures. Meshkati's (1988) model includes four sections:

- The Task and Environmental Variables;

- Operator's characteristics and Moderating Variables;
- Difficulty, Responses and Performances; and
- Mental Workload Measures.

The model takes into account three groups of measurement techniques: performance measures, subjective measures and psychological measures.

For the purpose of this study all the existing measures are reviewed in the context of the development of a new workload measure.

2.5.2 The criteria and process for the analysis of workload assessment measures

In order to make an informed decision regarding the use of different measurement techniques it is important that the evaluation of the measurement techniques is grounded on sound research criteria. De Waard (1996) states that different measures possess different properties, some measures focus on mental workload and other measures emphasise physical workload. The following criteria have been researched extensively:

- *Sensitivity:* The measure's ability to detect changes in the difficulty level of the task or the task demands (Kruger, 2005).
- *Diagnosticity:* The extent to which the measure has the ability to discriminate between the type or cause of workload and attribute the cause to certain factors of the operator's task (Wierwille & Eggemeier, 1993).
- *Validity:* The measure must measure the concept it is designed to measure.
- *Intrusion:* The extent to which the technique degrades ordinary and/or primary task performance. Disruptions in ongoing task performance as an outcome of the application of the technique are undesirable and should be minimized (De Waard, 1996).
- *Reliability:* The measure should be consistent within and across tests (Kruger, 2005).

- *Implementation* Requirements: The practical constraints associated with the complexity of the measurement procedures, including factors such as equipment and/or training (De Waard, 1996).
- *Human Operator Acceptance:* This factor refers to the operator's approval of the technique in terms of the validity and usefulness of the measure (De Waard, 1996).
- *Affordability:* The cost effectiveness of the administration, analysis and application of the measure (Kruger 2005).

When possible all criteria should be addressed in the selection or development of a workload measure. For the purposes of this study the criteria of sensitivity, diagnosticity, validity, intrusion and affordability are emphasised.

Farmer and Brownson (2003) outline the following process to be followed in the selection of a workload measure.

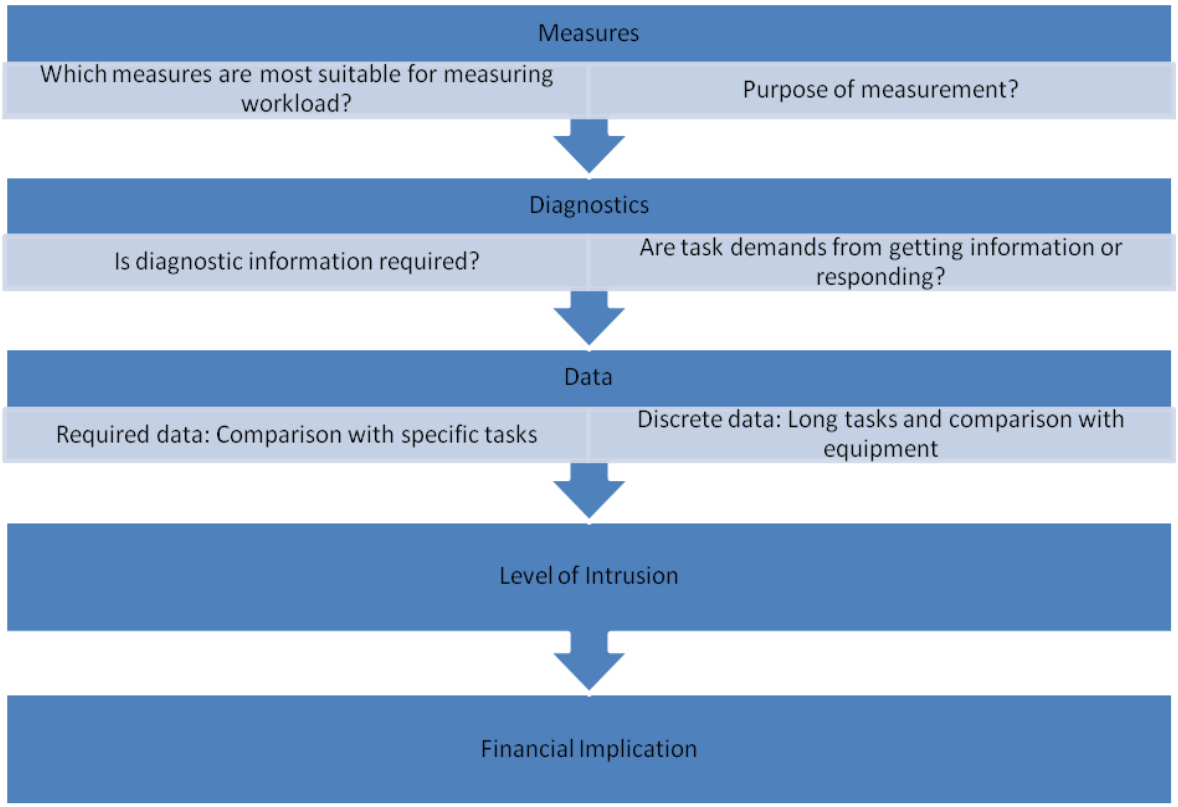

Figure 2.9. Selection Process

During the selection of a measurement technique this process and the criteria described above will be taken into account.

2.5.3 Contextualisation of workload assessment techniques

Kruger (2005) defines workload measurement methods as attempts to transform the theoretical construct of workload into practical methods for the achievements of workload.

2.5.3.1 Primary task performance measures

Performance-based measures can be divided into primary-task and secondary-task measures (Farmer & Brownson, 2003). The primary task is the task for which the workload is being considered while the secondary task is artificially added to determine the amount of spare mental capacity available when the human operator is executing the primary task (Farmer & Brownson, 2003). The level of performance on the secondary task should decrease due to the demand of the primary task. Fatigue can also play a role in decreasing work performance.

Kruger (2005) suggests that workload measures can make use of either analytical or synthetic methods of measurement. The analytical method examines the detail of the actual performance of the task, focusing on factors such as overall achievement and the methods used to obtain this achievement (Kruger, 2005). In contrast, the synthetic method focuses on the performance demands based on task analysis and compares the required time with the available time (Kruger, 2005).

According to Farmer and Brownson (2003) primary-task measures provide a direct indication of the task performance and are a useful index of spare capacity. Primary-task measures are also indicated in secondary-task performance. The difficulty with primary-task performance measures is that they can be insensitive to changes such as increased effort and changing demands of the primary task (Farmer & Brownson, 2003). In addition, the common application of this method to all tasks raises questions regarding its generalisability (Kruger, 2005)

2.5.3.2 Secondary measures

The majority of research is based on the evaluation of spare mental capacity. Spare mental capacity is defined as the difference among the total workload capacity and the capacity required to conduct the task (Kruger, 2005). This means that as the spare mental capacity decreases the human operator's level of workload increase. This continues until a point of overload is reached.

Wickens and Hollands (2000) identify two advantages of secondary measures. First, secondary measures have a high degree of face validity. Second, the exact secondary task can be applied to different primary tasks and will provide workload measures in the same units. However, secondary measures have several disadvantages that are relevant to this study. These disadvantages include intrusiveness, inconvenience. Secondary tasks can also be dangerous when the primary task is one that involves a high level of danger – such as flying (Kruger, 2005).

2.5.3.3 Subjective rating techniques

Subjective assessments or self-reporting are valid assessments of the effect of the overall workload on the human operators' working memories (Kruger, 2005). According to Eggemeier (1988), the majority of subjective measures focus on the operators' experienced effort, capacity expenditure and personal opinions regarding workload. In other words the method relies on the human operators' to express their personal feelings in terms of their workload.

Subjective measures of workload include the Cooper-Harper Scale (Wiewielle et al., 1985) the Subjective Workload Assessment Technique (SWAT) (Reid & Nygren, 1988) and the NASA Task Load Index (TLX) (Hart & Staveland, 1988). These measures have been widely used in numerous countries and in different languages. It is therefore important that these measures be considered in the context of the development of an assessment tool.

2.5.3.3.1 The modified Cooper-Harper (mc-h) scale

This scale measures perceptual, meditational and communication activities and used to obtain estimates of mental workload (Kruger, 2005). The scale has been adapted to distinguish between psychomotor workload and mental workload.

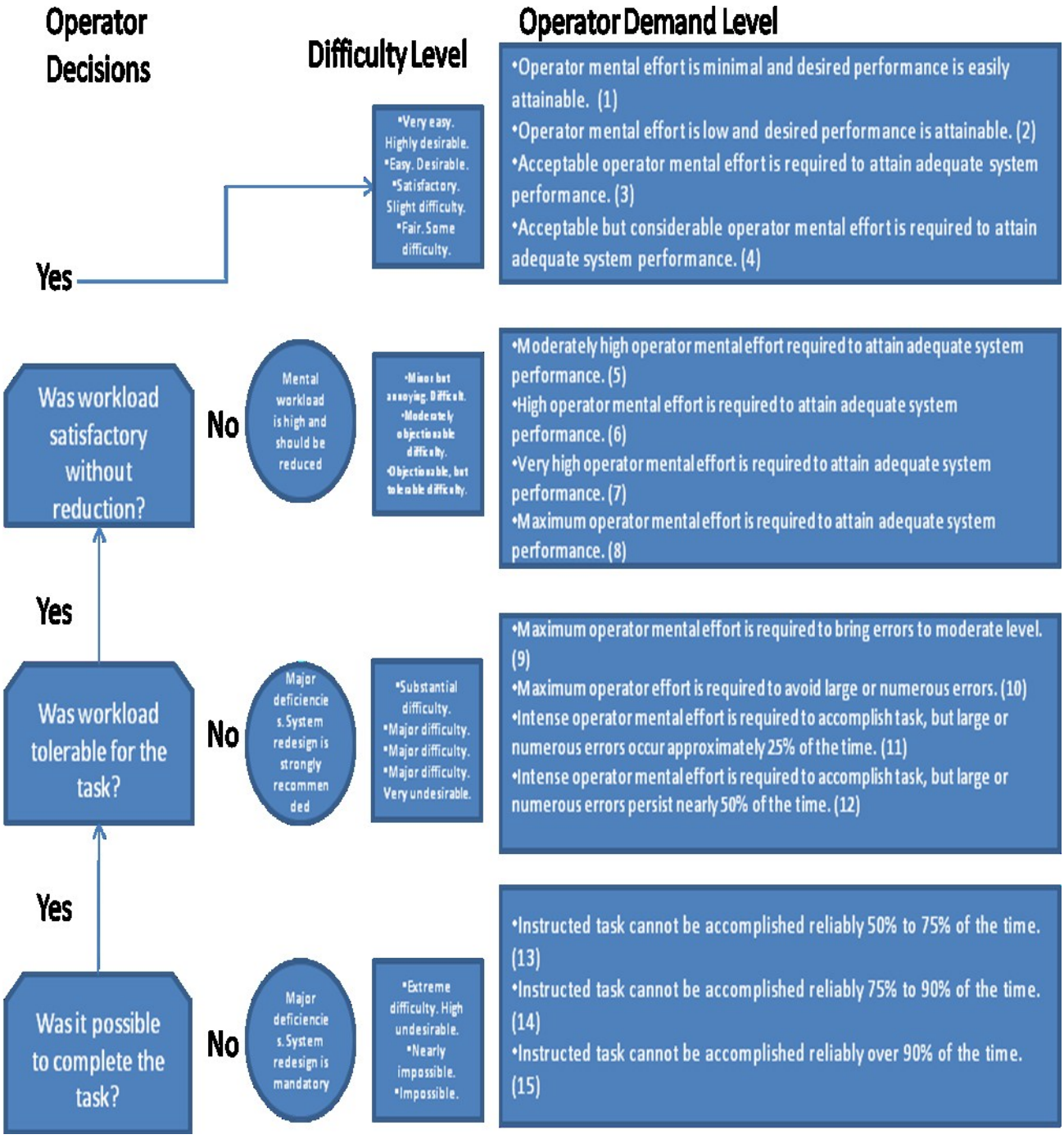

Figure 2.10. The Modified Cooper-Harper (MC-H) Scale

Note: From *A systems approach to the assessment of mental workload in a safety-critical environment,* p. 66 by A. Kruger (2005). Pretoria: University of Pretoria.

2.5.3.3.2 The Bedford scale

The Bedford Scale is very similar to the Modified Cooper-Harper (MC-H) Scale and makes use of the same 10-point scoring system, where 1 is very insignificant and 10 is very significant. The scale defines workload as the human operator's subjective experience of effort and takes into account the operator's ability, experience and response to stress (Kruger, 2005).

Cilliers (1992) criticises the scale by emphasising its lack of linearity, sensitivity and validity. The scale can be used when developing a workload measure but researchers should take cognisance of its drawbacks.

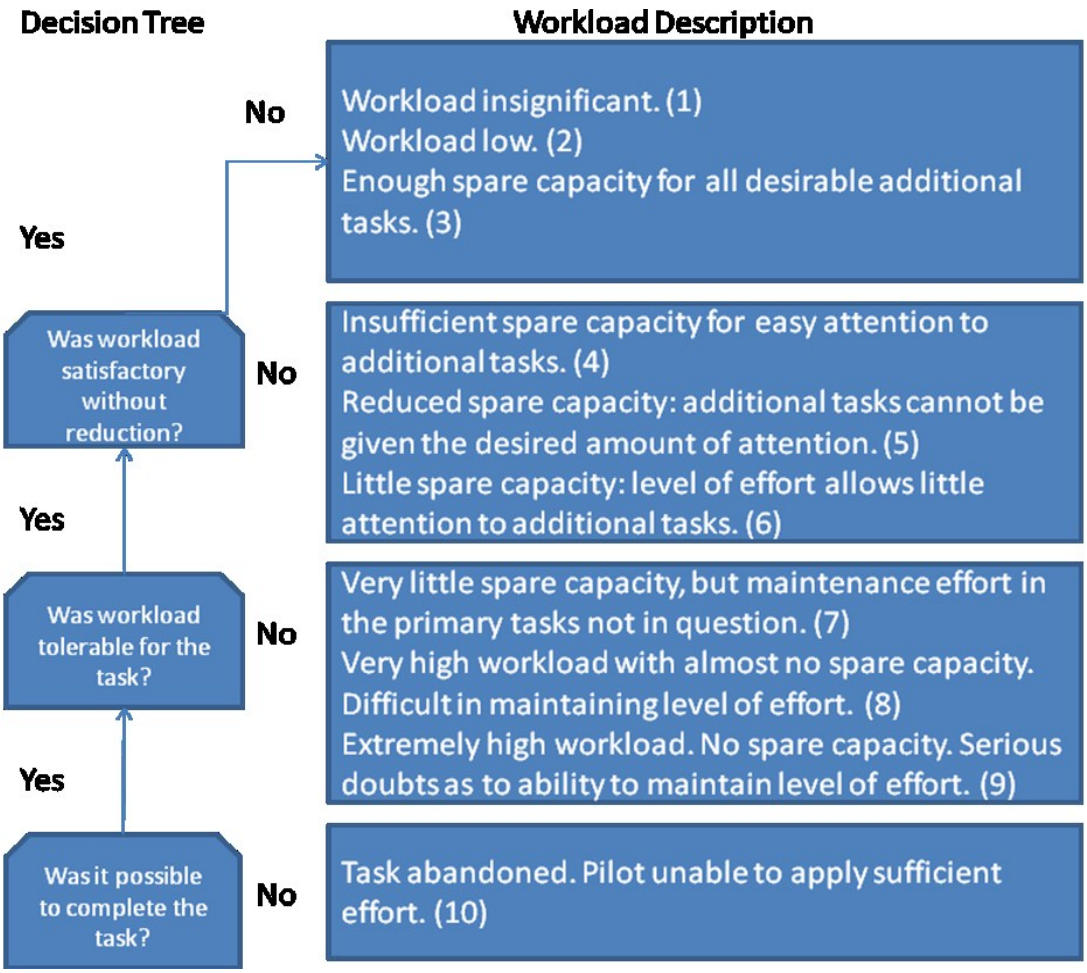

Figure 2.11. The Bedford Scale

Note: From *A systems approach to the assessment of mental workload in a safety-critical environment,* p. 68 by A. Kruger (2005). Pretoria: University of Pretoria.

2.5.3.3.3 The subjective workload assessment technique (SWAT)

The Subjective Workload Rating Technique is a multidimensional rating scale specifically developed to determine operator workload in numerous systems for different tasks (Reid & Nygren, 1988).

The design of the SWAT was based on three principles (Kruger, 2005):

- Accurate measurement and reduced intrusiveness of data collection;
- Minimal measurement constraints on the level of complexity of the judgment task that the human operator is required to make for workload estimations; and
- Development of a device for testing the validity of the formal measurement model based on the underlying additive model by SWAT.

The next step involved the development of the SWAT measurement. The SWAT was originally designed to measure pilots' mental workloads (Reid & Nygren, 1988). The measurement involves two-steps: the scale development phase and the event-scoring phase. The first phase involves the development of a workload scale by the operators and the second phase entails the rating of workload associated with a particular task (Kruger, 2005). The operators thus develop the workload scale in a group and then rate the items individually.

The SWAT makes use of three three-point scales labelled time load, mental effort load and stress load (Kruger, 2005; Wickens & Hollands, 2000).

Table 2.3. SWAT Scales

Time Load	**Mental Effort Load**	**Stress Load**
Level 1: Often have spare time - Interruptions or overlaps among tasks occur infrequently or not	*Level 1: Limited mental effort or concentration necessary* - Task are automatic, and need little or limited attention	*Level 1: Limited confusion, risk, frustration or anxiety exists and can be easily managed*

at all		
Level 2: Occasionally have spare time - Interruptions or overlaps among tasks occur frequently	*Level 2: Intermediate mental effort or concentration necessary* - Tasks are moderately complex because of uncertainty, predictability or unfamiliarity. - Intermediate levels of attention required	*Level 2: Intermediate stress experienced because of confusion and anxiety* - Significant compensation is necessary in order to obtain adequate performance
Level 3: Rarely, almost never have spare time - Interruptions or overlaps among tasks are very frequent or happen all the time	*Level 3: Extensive mental effort and concentration is required* - All attention resources are required due to tasks complexity	*Level 3: High levels or intense stress experienced because of confusion, frustration or anxiety* - High or extreme levels of determination and self-control are necessary.

Note: From Wickens, C. D. & Hollands, J. G. (2000). *Engineering Psychology and Human Performance* (3rd ed), by C.D. Wickens and J.G. Hollands (2000), New York: Prentice-Hall Inc.

The SWAT has been widely used in aircrew studies. Based on Farmer and Brownson's (2003) analysis the table below evaluates the SWAT based on the criteria for analysing assessment measures.

Table 2.4. Analysis of SWAT Measurement

Criteria	**Description**
Reliability	The measurement is reliable even if reporting is delayed by up to 30 minutes.
Validity	The dimensions are not empirically validated.
Sensitivity	High sensitivity level.
Diagnosticity	The scales are multidimensional and differentially diagnostic. The scales are labelled time load, mental effort and stress load.
Practicality	The measurement follows two steps: Scale development (ranking of 27 scale combinations) and event scoring.

Intrusiveness	The measurement is somewhat demanding with step 1 taking approximately 105 minutes. This results in lower user acceptance.

Kruger (2005) identifies SWAT as one of the most sophisticated workload measurements available. However, Hart (1986) identifies the following practical and theoretical obstacles:

- The measure's between-subject variance is high and the standard deviations are estimated at 70-80%;
- The measure includes a lengthy development phase (Gingell, 2003);
- The developers' optimistic assumption that operators can correctly predict the 27 combinations of abstract variables of workload;
- The measure's high inter-rate reliability may be merely an indication of an agreement on the extremes of workload; and
- The measure's limited factors characterising workload.

The literature makes it evident that the SWAT provides useful data but the criteria analysis table confirms that the measurement can only be utilised for scale development purposes.

2.5.3.3.4 The Nasa task load index (tlx)

The NASA-TLX was developed as part of a research program conducted over several years that aimed to identify the dimensions coupled with differentiations in subjective workload within and between different types of tasks. The tasks ranged from simple cognitive and manual control tasks to complex laboratory and supervisory control tasks and aircraft simulation (Hart & Staveland, 1988). The scale includes a multidimensional rating scale, in which information about the magnitude and source of six workload-related factors is integrated to derive a sensitive and reliable approximation of workload (Hart & Staveland, 1988; Kruger, 2005).

Table 2.5. The NASA Bipolar Rating Scale Descriptions

Title	Endpoints	Descriptions
Overall Workload	Low, High	The total workload associated with the task, taking into account sources and components.
Task Difficulty	Low, High	Whether the task was easy or demanding, simple or complex, exacting or forgiving.
Time Pressure	None, Rushed	The amount of pressure you felt due to the rate at which the task elements occurred. Was the task slow and leisurely or rapid and frantic?
Performance	Failure, Perfect	How successful you think you were in doing what we asked you to do and how satisfied you were with what you accomplished.
Mental/Sensory Effort	None, Impossible	The amount of mental and/or perceptual activity that was required (e.g. Thinking, deciding, calculating, remembering, looking, searching).
Physical effort	None, Impossible	The amount of physical activity that was required (e.g. pushing, pulling, turning, controlling, activating).
Frustration Level	Fulfilled, Exasperated	How insecure, discouraged, irritated and annoyed versus secure, gratified, content and complacent you felt.
Stress Level	Relaxed, Tense	How anxious, worried, uptight and harassed or calm, tranquil, placid and relaxed you felt.
Fatigue	Exhausted, Alert	How tired, weary, worn out and exhausted or fresh, vigorous, and energetic you felt.
Activity type	Skill-based, Rule-based, Knowledge-based.	The degree to which the task required mindless reaction to well-learned

		routines or required the application of known rules or required problem solving and decision making.

Note: From "Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research" by S. G. Hartland and L. E. Staveland (1988) in P.A. Hancock & N. Meshkati (Eds), *Human Mental Workload*. p. 240. Amsterdam: North Holland Press

Each scale includes bipolar descriptions (high/low). Numerical values are not displayed, but values ranging from 1 to 100 are assigned to scale positions during data analysis. This set of scales was used in twenty-five studies investigating subjects' experiences of workload (Kruger, 2005).

Hart and Staveland (1988) report a number of key points that emerged from the subjects' subjective experiences and evaluations of workload.

- A factor exists that can be termed workload, but its specific roots may differ from one task to the next.
- Ratings of component factors are more diagnostic than general workload ratings.
- Subjects' workload definitions and conceptualisations differ, which contributes to between-subject variability. However, the specific sources of loadings imposed by a task are more potent determinants of workload experiences than such individual biases.
- A weighted combination of the magnitudes of factors that contribute to subjects' workload experience during different tasks provides a general measure of workload that is relatively stable between raters (Kruger, 2005).

Hart and Staveland's (1988) research resulted in the development of the NASA-TLX rating scale. The scale contains numerous subscales and these are described below.

Table 2.6. NASA-TLX Rating Scale Definitions

Title	Endpoints	Descriptions
Mental Demand	Low, High	How much mental and perceptual activity was required (e.g. thinking,

		deciding, calculating, remembering, looking, and searching)? Was the task easy or demanding, simple or complex, exacting or forgiving?
Physical Demand	Low, High	How much physical activity was required (e.g. pushing, pulling, turning, controlling, activating, etc.)? Was the task easy or demanding, slow or brisk, slack or strenuous, restful or laborious?
Temporal Demand	Low, High	How much time pressure did you feel due to the rate or pace at which the tasks or task elements occurred? Was the pace slow and leisurely or rapid and frantic?
Performance	Good, Poor	How successful do you think you were in accomplishing the goals of the task set by the experimenter (or yourself)? How satisfied were you with your performance in accomplishing these goals?
Effort	Low, High	How hard did you have to work (mentally and physically) to accomplish your level of performance?
Frustration Level	Low, High	How insecure, discouraged, irritated, stressed and annoyed versus secure, gratified, content, relaxed and complacent did you feel during the task?

Note: From "Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research" by S. G. Hartland and L. E. Staveland (1988) in P.A. Hancock & N. Meshkati (Eds), *Human Mental Workload*. p. 240. Amsterdam: North Holland Press

The reliability and validity of the scale have been extensively researched (Hart & Staveland, 1988). Farmer and Brownson (2003) analysed the NASA-TLX as demonstrated in table 2.7.

Table 2.7. The Analysis of NASA- TLX

Criteria	**Description**
Reliability	High Reliability
Validity	Validated in various contexts
Sensitivity	Sensitivity of measurement is high
Diagnosticity	The NASA-TLX is multidimensional and the six subscales make the measurement differentially diagnostic
Practicality	The measurement consists of the several steps, the first step consists of a paired comparison weighting process to estimate the importance of every factor
Intrusiveness	The measurement takes approximately 1 or 2 minutes to complete

2.5.3.3.5 The workload profile (wp)

The Workload Profile (WP) is a multidimensional instrument for the assessment of subjective mental workload and is a fairly new addition to the family of workload measures (Kruger, 2005). This instrument is based on Wickens' (1992) multiple resource models. The WP endeavours to combine the advantages of secondary-task performance-based procedures (high diagnostic ability) and subjective techniques (high subject acceptability, low implementation requirements, low intrusiveness) (Kruger, 2005). The WP asks subjects to indicate the fraction of attention resources that they have used after they have experienced all of the tasks.

Previous studies have evaluated the characteristics of the WP and compared them to those of the NASA-TLX and SWAT.

Table 2.8. Analysis of WP

Criteria	**Description**
Sensitivity	Very high
Diagnosticity	The measurement comprise of a very high level of diagnosticity

Intrusiveness	Low

Note: From Rubio, S., Diaz, E., Martin, J., & Puente, J. M. (2004). "Evaluation of Subjective Mental Workload: A Comparison of SWAT, NASA-TLX, and Workload Profile Methods" by S. Rubio et al. (2004) *Applied Psychology: An International Review*, 53(1).

2.5.3.3.6 Advantages and disadvantages of subjective ratings

The use of subjective rating scales has several clear benefits. Firstly, subjective measures have high 'face validity' and are therefore more acceptable to human operators (Gingell, 2003). The measurements also tap into the operator's experience of the workload and this also increases user acceptance. Operators may tend to be more open and honest when completing these subjective measures because they feel that their feelings are taken into consideration. In addition, subjective ratings do not disrupt primary-task performance and are relativity easy to administer and interpret (Kruger, 2005). Analysis suggests that most subjective measurements are reliable, valid and sensitive and have differential diagnosticity. These measures also tend to be practical and have low levels of intrusiveness. Operators also find it easy to assign ratings to subjective measurements (Farmer & Brownson, 2003).

A serious disadvantage of subjective measures is the lack of agreement on the nature of the components of workload and therefore on the scales that should be utilized in subjective measurements (Farmer & Brownson, 2003). Subjective measures thus rely on operator's perceptions, which can be an unreliable reflection of the operator's workload (Kruger, 2005).

Despite the drawbacks mentioned above the workload instrument developed in the current research makes use of the subjective approach. This subjective approach is appropriate and inexpensive and measures the constructs of interest for the study.

2.6 PSYCHOMETRICAL CONSTRUCTS

Psychometrics has an impact on the lives of numerous South Africans (Sehlapelo & Terre Blanche, 1996). In the South African context psychological tests are used for selection placement, promotion, transfers, training and development (Kemp 1999; Shaw & Human, 1989; Taylor & Radford, 1986; Van der Merwe, 1999). It is therefore important that these psychometric tests are reliable and valid (Bedell, Van Eeden & Van Staden, 1999; Van der Merwe, 1999). This section provides a short discussion of the development of psychometrics in South Africa and includes a discussion of the prerequisites for psychometric tests. The following section focuses on the importance of reliability and validity.

2.6.1 The history and development of psychometrics in South Africa

Psychometrics used to aid in occupational decisions, including the selection and classification of human resources. However, employees tend to have little trust in tests and testing processes (Kemp, 1999; Sehlapelo & Terre Blanche, 1996). Within the South African context the history of psychometrics is one of racism and discrimination (Sehlapelo & Terre Blanche, 1996) as the psychometric tests used were biased, irrelevant and unfair in relation to the black population (Shaw & Human, 1989). Instruments that do not respect diversity lead to unfair discrimination, especially for previously disadvantaged individuals (Erasmus, 1998). These instruments should not be used indiscriminately within the South African context. The issue of fairness in testing is thus related to a concern for securing equal opportunity for all. For example, within the workload measurement instrument fairness is ensured by making sure that the items are clearly understood by all operators. In order to ensure fairness alternative methods for measuring different constructs should be designed that suit the South African context (Shaw & Human, 1989). Despite these obstacles psychometric tests continue to be used extensively throughout South Africa. With the publication of the Employment Equity Bill and the draft policy of the Professional Board of Psychology on the classification of Psychometric Measuring Devices, Instruments, Methods and Techniques the South African government is now putting pressure on test developers and test users to upgrade, enhance and validate existing psychometric instruments so to ensure fair testing practices (Bedell et al., 1999; Eckstein

(1999) cited in van der Merwe, 1999). The Employment Equity Bill states that: “Psychometric testing of an employee is prohibited unless it has been validated and measures have been taken to ensure that is it culturally fair and unbiased towards members of designated groups” (Employment Equity Act (1995) cited in Erasmus, 1998). This legislation means that psychometric tests can only be used if their reliability and validity is scientifically proven and they are not biased against any employee or group (Bedell et al., 1999). The legislation therefore supports the rationale for the development of a workload measure that is reliable and valid for the South African context.

Huysamen (1996) states that one of the major stumbling blocks with regards to the use of psychometric measurements in South Africa is related to the complexity of creating tests that can be used across a diversity of linguistic and cultural backgrounds. Practitioners in the field of psychometric testing are aware of the need for the development of valid and reliable tests for use within the multicultural South African context (Bedell et al., 1999). In general, studies support the view that South African tests are reliable and valid for the groups for which they were developed and standardized.

2.6.2 Reliability and validity

The fairness of any assessment measure is dependent on the steps followed in its standardisation, validation and determination of reliability (Erasmus, 1997). Psychometric testing is a necessary part of instrument development. The first step in psychometric testing involves determining the psychometric test’s reliability and validity for that particular sample.

2.6.2.1 Reliability

Smith and Robertson (1986) define reliability as the extent to which scores on a measure are free from random errors. Price (1997) explains reliability as the extent to which a measure produces the same results when used repeatedly. In this definition reliability is resulted to a measure’s consistency. Reliability is also a measure of the confidence with which instrument scores can be regarded. According to Schaap (2003) as cited in Schaap

and Erasmus (2003) it is not possible to refer to an instrument's reliability. Instead, reliability simply tells one how confident one can be that the scores obtained with the instrument are consistent and accurate (Schaap, 2003 as cited in Schaap and Erasmus 2003). Reliability is thus relative and can be influenced by the group to whom the instrument is administered. Reliability, when calculated appropriately, indicates the relation between true scores and observed scores. This is known as the standard error of measurement and provides a direct indication of the degree of inconsistency or error within individual scores (Schaap, 2003 as cited in Schaap and Erasmus 2003).

There is no fixed value for acceptable reliability (Schaap, 2003 as cited in Schaap and Erasmus 2003) and acceptable levels of reliability are dependent on the nature and purpose of the measure. Cognitive related ability instruments should generally have higher reliability coefficients. A reliability coefficient of 0.6 is generally considered acceptable for social and emotional indices and a coefficient of larger than 0.7 is usually regarded as acceptable for cognitive indices Kriel (2003) as cited in Schaap and Erasmus (2003) (2003).

When only one measure is available the reliability coefficient should be as high as possible (Schaap, 2003 as cited in Schaap and Erasmus 2003). The range of individual differences within the group influences the size of the reliability coefficient and must be taken into account. According to Schaap (2003) as cited in Schaap and Erasmus (2003), heterogeneous groups tend to have higher reliability coefficients than homogenous groups. Variance due to content heterogeneity can also influence the reliability coefficient. The more homogenous the items are the higher the coefficient will be. With this consideration in mind the workload measurement developed in this study aimed to make use of fairly homogeneous items.

The best way to establish the reliability of a measurement is to use it repeatedly on the same object (Smith & Robertson, 1986). However, several methods exist for establishing an instrument's reliability (Smith & Robertson, 1986). Some of these methods are discussed below.

- Parallel form reliability is used when two equivalent/parallel versions of the same test are used on the same group on different occasions.
- Test-retest reliability is used when the same test is re-administered to the same sample after a short time interval.
- Internal consistency reliability refers to the homogeneity of the test items. The homogeneity of the test items can be determined through the use of the split-half reliability method, the Kuder Richardson's formula or Cronbach's alpha. The Kuder Richardson's formula is generally used when the items are scored in terms of pass or fails, whereas Cronbach's alpha is used when items are scored on a continuum. Although recommendations vary, 0.7 is often viewed as the minimum acceptable level for Cronbach's alpha (Price, 1997).

It is important to remember that an instrument can be reliable without being valid valid (Smith, 1991). However, if order for an instrument to be valid it must also be reliable (Smith, 1991). Reliability is thus a necessary but insufficient requirement for validity. The multifaceted concept of validity is discussed in the section below.

2.6.2.2 Validity

2.6.2.2.1 Defining validity

Workload measurements such as the NASA-TLX and SWAT make inferences about subjects based on their individual differences. A decision must then be made regarding the validity of these inferences (Welman, Kruger, & Mitchell, 2005). Validity is defined as the extent to which an instrument measures what it is designed to measure. If conclusions are to be drawn from findings then it is important that the items generated and the scale constructed measure what they are designed to measure. In this particular study the workload instrument is designed to measure mental demand, physical demand, temporal demand, effort, own performance and frustration level.

According to Salkind (2006) validity must be viewed in context. He proposes three important factors that must be taken into account when referring to validity (Salkind, 2006):

- Validity is concerned with the outcomes and results of a test;
- Validity varies on a continuum of degrees of validity from low validity towards high validity;
- The results of tests' validity should always be viewed from the context within which the measurement takes place.

The inferences made in relation to an instrument concern (1) the attributes of the instrument itself and (2) the attributes of the participant being tested (Welman et al., 2005). For the purposes of this study inferences are made concerning the instrument itself.

2.6.2.2.2 Construct validity

Construct validity is defined as the extent to which a measure measures the theoretical construct (e.g. workload) or trait (e.g. numerical ability) that it is designed to measure (Foxcroft & Roodt, 2005). Within this study traits are defined as factors contributing to the workload subscales, for example thinking is a trait of mental demand.

Salkind (2006) indicates that determining construct validity is both time consuming and difficult but is very necessary. The conceptual definition for construct validity is the degree to which the outcome of a test is related to the underlying psychological construct. This means that the test score are related to an underlying theory that explains the phenomenon. Foxcroft and Roodt (2005) describe various methods of establishing construct validity. The first method involves finding correlations between the current measure and previous measures that already have construct validity. The second method involves illustrating the difference between groups in the current measure. The third method involves evaluating the task requirements of the items in the test and calculating whether these requirements are concurrent with the underlying theory (Salkind, 2006). Determining construct validity involves the use of multiple statistical measures including correlation analysis, factor analysis, content analysis and ANOVA (Foxcroft & Roodt, 2005).

It is important that multiple strategies are used to determine construct validity, as test takers seem to have more trust in tests that are proven to be reliable and valid. Reliable and valid tests therefore increase respondents' honesty. To summarise, the construct validity should be evident in multiple strategies.

Once construct validity has been determined convergent and discriminant validity must be investigated. These two forms of validity are discussed in the section below. Other forms of validity are discussed in later sections.

2.6.2.2.3 Convergent and Discriminant Validity

Convergent Validity

Welman et al., (2005) state that construct validity refers to high relationships with other measures of the same construct. Convergent validity includes internal consistency validity, which is described as the correlation of the given scale with measures of the same construct in different scales and instruments. Thus, two scales measuring the same construct should produce similar results. Convergent validity also implies that responses can be generalised across the items within a test. This means that if a test-taker performs well on one half of the test they should also perform well on the other half of the test (Welman et al*.,* 2005). Cronbach's alpha coefficients are usually used to determine internal consistency construct validity. Scores of 0.60 are considered appropriate for exploratory analysis, whereas scores of 0.70 are considered adequate for confirmatory analysis and scores of 0.80 are considered good for confirmatory analysis (Welman et al., 2005).

Discriminant Validity

Discriminant validity involves the presence of low levels of correlations between different constructs (Welman et al., 2005). Discriminant validity helps to determine differences and overlaps between constructs.

2.6.2.2.4 External validity

External validity is concerned with the generalisability of results. Welman et al. (2005) states that external validity consists of population validity and ecological validity. Population validity is the extent to which findings obtained for the measurement can be generalised to the population as a whole, while ecological validity involves the extent to which findings can be generalised to all situations and circumstances that are assumed in the research study (Welman et al., 2005). In order to ensure that construct validity is present it must be possible to generate similar relationships from different samples. Constructs need to be consistent across different populations in order to ensure similar relationships across the different samples.

2.6.2.2.5 Criterion validity

Criterion validity is defined as the extent to which an instrument accurately predicts future performance based on the relevant criterion (Welman et al., 2005). Foxcroft and Roodt (2005) state that criterion validation is a quantifiable process that involves the calculation of a correlation coefficient between a predictor and a criterion. There are two types of criterion-related validity. Concurrent criterion-related validity is the accuracy with which a measure can define and diagnose an individual's current behaviors or characteristics. Predictive validity criterion-related validity refers to the accuracy with which a measure can determine an individual's future behaviors (Foxcroft & Roodt, 2005).

2.6.2.2.6 Content validity

Content validity refers to the extent to which a measure's content covers a representative sample of the behavior of the aspects being measured (Foxcroft & Roodt, 2005). In terms of this study content validity refers to the extent to which the workload subscales represent the contributing behaviors of workload.

2.6.2.2.7 Factorial validity

A factor analysis analyses the interrelationships between variables. Factor analysis is used to identify the common variance between variables and reduce a large number of variables to a small number of factors (Foxcroft & Roodt, 2005). Hayton, Allen and Scarpello (2004) define factor analysis as a statistical measure that determines the number and nature of the common factors required to account for patterns of observed correlations.

2.6.2.2.8 Incremental validity

Incremental validity occurs when a measure explains more additional numerical variance than a set of other measures designed to measure the same variables (Foxcroft & Roodt, 2005). For example, a measure of workload has incremental validity if it explains more variance than other measures of workload. In this research study the instrument developed is designed to explain more variance than existing measures such as the SWAT.

2.6.2.2.9 Differential validity

A measure has differential validity when it is successful in distinguishing differences between organisations, groups or individuals (Foxcroft & Roodt, 2005). Workload measures possess differential validity if they can differentiate between different individuals' workload levels.

In practice construct validity is rarely evaluated on its own but is instead described through the operationalisation of the variable and the researcher's judgment regarding the success of this operationalisation (Welman et al., 2005). This is also true in terms of the determination of the construct validity of the dependant variable. These outcomes then provide feedback on both the theory and the tenability of the construct validity of the independent variable.

The discussion in the preceding sections highlighted the importance of reliability and validity in test development. It is vital the tests that are developed are credible, valid, reliable and fair.

2.7 SHORTCOMINGS AND LIMITATIONS OF PREVIOUS RESEARCH

Previous research and discussions pertaining to workload have included several limitations. These discussions lack a comprehensive framework that encompasses a holistic view of workload.

The literature review showed that most previous research focused on mental workload and not on overall workload. Although it is evident that workload is understood as a holistic function, no comprehensive research regarding this comprehensive view exists.

In order to address these shortcomings the instrument developed in this research study aimed to provide a holistic view of workload.

The literature review also showed that no instrument exists to measure the constructs of interest in this study. The development of a new instrument is therefore justified.

2.8 CONCLUSION

The literature reviewed in this chapter provides a firm foundation for the study and presents information in relation to some of the objectives outlined in chapter 1. The chapter also includes a substantial body of information regarding the research process and scale development.

The literature review provided adequate qualitative information regarding the concept of workload. However, the framework of these elements was verified and analysed by subject matter experts and was deemed relevant for inclusion in the workload measurement. The last section of this chapter provides a short discussion regarding the development of psychometrics in South Africa and specifically focuses on the need for all instruments to

be valid and reliable. The substantiation and analyses of the structure and descriptive elements of the workload measure are discussed in detail in Chapter 3.

This chapter provided a comprehensive discussion of workload, workload variables and currently available workload measures. The chapter concluded with a discussion of psychometrical constructs in scale development research. The chapter established a solid foundation for the development of items for the workload scale.
In chapter 3 the rationale for the research methodology is discussed with reference to relevant literature.

CHAPTER 3

Research Design and Methods

"Research is creating new knowledge"

Neil Armstrong

3.1 INTRODUCTION

The purpose of this chapter is to clarify the method of enquiry, the rationale, steps and methodology behind the study. The use of a quantitative research methodology and the use of inductive and deductive reasoning in the research progression are discussed. The chapter also outlines the explicit phases of the research. Finally, the rationale for using subject matter experts and the data collection method are described.

3.1.1 Theoretical framework

Leedy (1997) describes research as the logical process of collecting and evaluating information in order to enlarge the understanding of the subject being researched. Research attempts to answer questions by following a logical process in order to resolve problems and gain a better understanding of occurrences.

According to Cooper and Schindler (2001, p. 18) "good research follows the standards of a good scientific method." Kerlinger (1986) indicates that good scientific research includes:

- An integrated theory;
- Open and unrestricted procedures;
- Accurate definitions;
- A logical, structured approach;
- Replicable data;
- Objective sampling methods and data collection processes;
- A clearly defined research problem; and
- A comprehensive understanding of the subject.

3.1.1.1 The research process

In order to ensure a focused, systematic and scientific process the research process used in this research as designed to mimic, to a close approximation, the Research Process Model defined by Cooper and Schindler (2001).

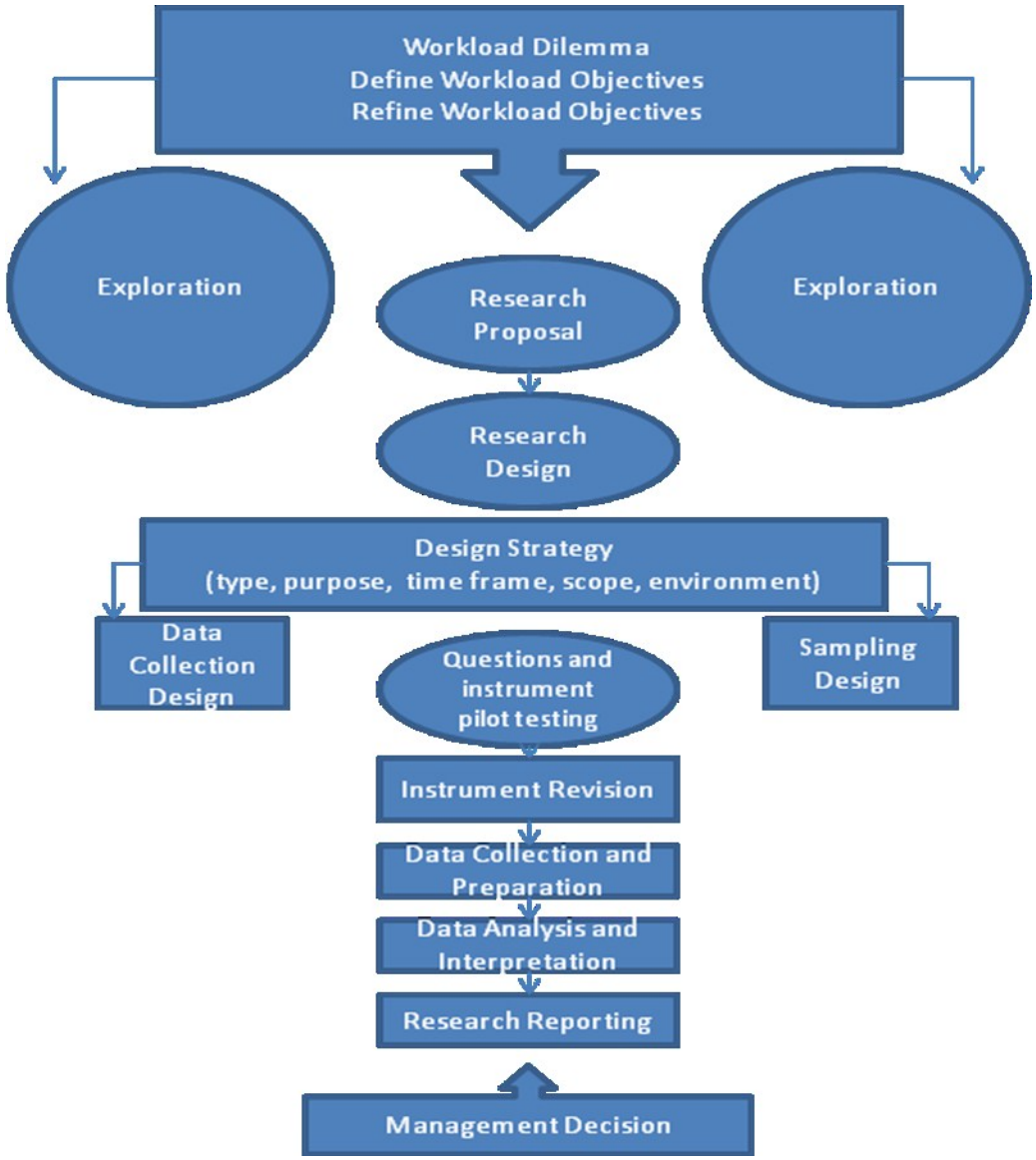

Figure 3.1. The Research Process

Note: From *Business Research Methods: International edition*, p.61 by D. R. Cooper and P. S. Schindler (2001) Singapore: McGrawHill.

3.2 RESEARCH PARADIGM / PHILOSOPHY

The research paradigm is the lens through which a researcher views the world and is thus synonymous with a worldview. According to Guba (1990) cited in Creswell (2008) a research paradigm is defined as the underlying beliefs and values that guide the researcher's actions and behaviors. The positivist worldview is guided by the researcher's field of study, the beliefs of advisors and previous research experiences (Cresswell, 2008). Scientific inquiry involves the need to address the research paradigm in terms of ontology, epistemology and axiology (Cresswell, 2008).

This study operates on the assumptions of a positivist worldview. According to Brand (2009) positivism forms the groundwork for the majority of empirical studies. Positivism is defined as a belief system that was born out of practices in the natural sciences and which assumes that subject matter can be evaluated objectively and and that truth can be determined with a reasonable amount of certainty. Crotty (1988, cited in Brand, 2009) states that scientific methods are needed to verify research falling within this paradigm. In other words, a scientific method should be used to analyse subject matter and to gather and collect data.

Hayes (2000) describes positivism as a scientific approach that distinguishes between 'positive' data (a sensory occurrence) and 'transcendental' (going beyond the data) assumptions of various kinds. Positivism insists that only phenomena that can be directly observed and calculated counts as knowledge. Any other type of information or approach to obtaining evidence is seen as being unscientific and is thus disregarded and discredited. This paradigm is appropriate for use within the current study as the study aimed to develop a scale that measures employees' subjective experience of workload overall. In order to develop this scale scientific evidence was gathered, and this corresponds to the positivist way of thinking. Positivist approaches thus quantify and measure the observable and generate scientific evidence. Table 3.1 summarises the main characteristics of positivism.

Table 3.1. The Main Characteristics of Positivism

	Positivism
Definition	Positivist research is concerned with objective data that uses scientific methods
Ontology	Reality is measurable and identifiable and consists of stable existing patterns that can be generalised and that is not context and time bound.
Epistemology	Researcher and participant are independent and standardised procedures are used to reduce bias.
Axiology Rhetorical Structure	The researcher's values are excluded from the study. Findings are provided in a scientific objective manner.
Method	Quantitative methods are utilized.
Researcher's role	Objective, neutral, distant

Note: From Ponterotto, J. G., & Grieger, I. (2007). "Effectively communicating qualitative research" by J. G. Ponterotto and I. Grieger (2007) *The Counselling Psychologist,* 35(3), p. 410.

Hayes (2000) identifies four key features of positivism.

1.) The positivist paradigm contains particular assumptions regarding causality. Within this paradigm causality is conditioned by the human mind when certain proceedings are seen as occurring together in space and time. Causes are believed to be replicable. This means that the causes of particular actions can be replicated in similar circumstances and would then result in similar outcomes.

2.) The positivist paradigm is based on the belief that the observer is utterly autonomous of what is being observed. Thus the researcher is an observing bystander to the events occurring during the research study.

3.) The positivist paradigm holds that scientific knowledge is value-free and takes place autonomously of culture and the social context. In other words research based on scientific foundations is not influenced by the participants' backgrounds.

4.) The positivist paradigm maintains that all sciences can and should be conducted in terms of a similar overall methodology.

This study focused on developing a scale to measure workload and therefore falls within the positivist worldview. The study therefore made use of scientific methods that are standardised, valid and reliable. The aim of the research was to generalise findings from the sample to the population, while remaining objective. Quantitative methods were used and results are presented in an objective manner.

3.3 DESCRIPTION OF INQUIRY STRATEGY AND BROAD RESEARCH DESIGN

The description of the strategy of inquiry relates to the designs or models that grant unambiguous procedures and guidelines for the research design (Creswell, 2009). In other words the strategy of inquiry serves as the direction and navigation for the particular study.

Research design is always guided by three questions:

- Which type of study will be conducted?
- Which type of study is most suitable for the particular research objectives?
- Which type of outcome is aimed at? (Mouton, 2001).

The current study made use of a quantitative strategy. Creswell (2009) states that during the late nineteenth and twentieth century's the positivist worldview became associated with quantitative research strategies.

This study made use of a quantitative research method involving the use of a non-experimental research design. Data collection was conducted through means of distributing questionnaires as part of a survey research design. The study involved empirical research through the collection and analysis of primary data. Saunders, Lewis and Thornhill (2007) define primary data as described as data that is composed for a specific research project being undertaken. In this study the researcher collected empirical data to address the research objectives. The research was undertaken with the aim of

increasing scientific knowledge regarding the overall workload experienced by employees from different organisations.

Non-experimental designs such as the one used in this study are often used in descriptive studies. In these studies the units that have been selected to participate in the research are measured on all the relevant variables at a certain point in time (Pieterson & Maree, 2007). Within this study individuals were selected to provide a depiction of the overall workload experienced by the individuals at a specific time. Non-experimental designs do not involve the manipulation of variables (Pieterson & Maree, 2007).

The current study made use of a survey design. Umbach (2005) states that new technologies have made surveys an effortless and inexpensive means of data collection, resulting in a proliferation of survey research designs. Table 3.2 contains Mouton's (2001) description of a survey research design.

Table 3.2. Survey Research Design

Definition	Quantitative nature that aims to present a sample that is representative.
Design Classification	The research is empirical in nature and collects primary data that is numeric and allows the researcher to have medium control.
Key Research Questions	The research is exploratory and descriptive.
Design Type	A cross-sectional survey is conducted, thus data is only be collected at one point in time.
Application	Organisational survey.
Meta-theory	Associated with positivist meta-theory and variable analysis.
Reasoning	Inductive and a-theoretical.
Sampling	Non-probability sampling.
Sources of data	Structured hard copy questionnaires (survey).
Analysis	Descriptive statistics.

Sources of Error	Sampling error; questionnaire error; high refusal rates; high non-response; respondent effects; data capturing error; use of unsuitable statistics techniques.

Note: From *How to succeed in your Master's and Doctoral studies: A South African guide and resource book*, p. 152 by J. Mouton (2001). Pretoria: Van Schaik Publishers.

Umbach (2005) indicates that survey methodologies involve a survey life cycle that consists of two processes: the measurement process and the representation or sampling process.

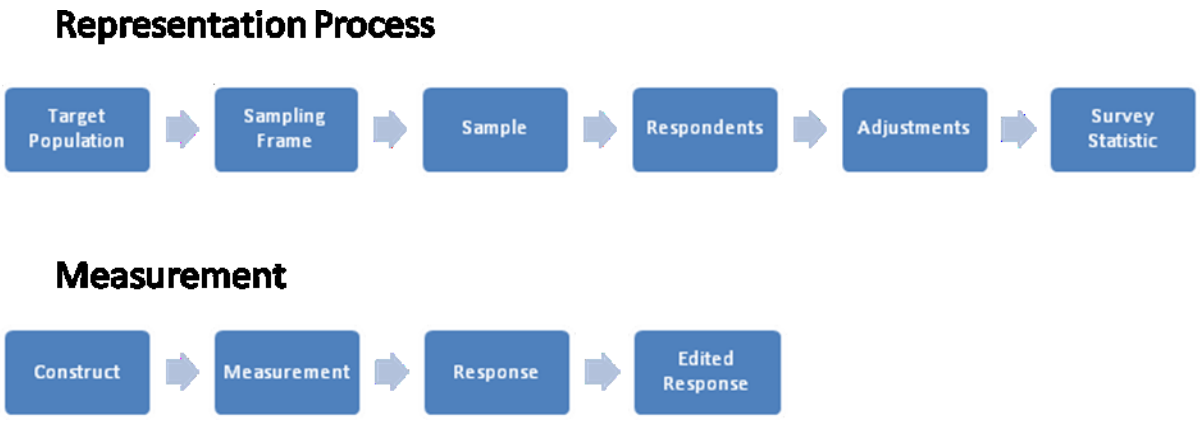

Figure 3.2. The Survey Life Cycle

Note: From "Getting back to the basics of survey research" by P. D. Umbach (2005) *New Directions for Institutional Research,* 127, p.92.

The measurement process starts with identifying a construct (workload) or developing an understanding of what the researcher wants to measure. This step is then followed by the development of a scale and tangible ways to gather information (Umbach, 2005). Participants provide data in the form of responses and the researcher edits these responses. The representation process begins with the identification of a target population from which a sampling frame (units of analysis) and sample is drawn. The participants in the sample that are successfully measured are referred to as respondents (Umbach, 2005).

The tools, methods and reasoning that were applied to carry out the research objectives identified in chapter 1 are presented in Table 3.3. This approach was established in accordance with the guidelines set out by Du Plessis (2004).

Table 3.3. Methodological Approach

Research Objectives	Approach	Reasoning
1. What are the components of the main construct (workload)?	Literature Study Descriptive	Inductive
2. What are the current measures available to measure workload? Do the measures meet the criteria identified?	Literature Study Descriptive	Inductive
3. What are the components of workload?	Literature Study Quantification of dimensions and substantiation by subject matter experts using Lawshe's (1975) content validity ratio.	Deductive
4. How should the construct (workload) be assessed?	Literature study on measurements and scale development. Quantitative verification and development of assessment tool. De Vellis (1991) scale development process.	Inductive
5. Which process would be appropriate for the	Item analysis and exploratory factor analysis.	Deductive

development of a workload measure?	Workload measurement.	

Note: From *The Development of an assessment model for Measuring Project Management Culture in Organizations,* p, 78, by Y. du Plessis, Pretoria: University of Pretoria.

3.3.1 Quantitative research

A quantitative research methodology was selected for this research based on the following advantages provided by this type of methodology:

- Measurement allows for distinguishing between unit of analysis (individuals) on the specific workload subscales dimensions;
- Measurement devices creates consistency over time and is a standardised data collection method;
- Results provide a statistical estimation of the relationship between constructs and the differences between groups based on the constructs (Kotze, 2009);
- Results can be generalised to large populations (population validity);
- Questionnaire construction employs high construct validity (Mouton, 2001); and
- Statistical objective data is obtained.

The rationale for selecting a quantitative approach involved the need for valid and reliable workload questionnaire for the South African population.

3.3.1.1 Research design

The study made use of a non-experimental, cross-sectional survey design. Welman et al., (2005) define non-experimental research as research in which one or more variables aside from the independent variable being tested could be the actual reason for observed variation in the dependant variable. The survey design involves the examination of the relationship that occurs among two or more variables without the option of intervention. Variables such as age, gender and socio-economic status are usually highly important within survey research (Welman et al., 2005). The cross-sectional nature of the survey

means that measurement occurred at one particular point in time. In this form of research criterion groups are normally drawn from different age groups, known as cohorts (Welman et al., 2005). Cross-sectional studies usually aim to present a description of the general picture of a phenomenon, a situational problem or an attitude or issue, by accessing a cross-section of a given population at a particular time (Jesson, 2001). The cross-sectional method is usually used in descriptive studies such as this one. This study therefore asked a number of questions to a broad range of people in order to address the phenomenon of workload.

A major advantage of cross-sectional research design is that it avoids problems relating to the use of longitudinal research designs. These problems are specifically related to longitudinal designs being time-consuming and costly, ultimately making respondents less interested in taking part in the research. A major limitation of cross-sectional design is that research is only conducted at one point in time and changes over time are thus ignored (Welman et al., 2005) The rationale and logic for selecting a cross-sectional design for this study was based on the limited availability of time and financial resources.

The survey was conducted by distributing questionnaires by hand to employed individuals at different organisations in South Africa. This survey was conducted at one point in time and no follow was done. The questionnaires were distributed by hand in order to ensure participants' confidentiality. This method of distribution was also convenient and easily accessible to participants. The data was then evaluated and analysed with the main aim of developing a subjective workload measurement for the South African population.

3.3.1.2 Respondents and Sampling

3.3.1.2.1 Target Population, Context and Unit of Analysis

The target population refers to the population from which data will be gathered. The target population from which the sampling frame for this study was chosen consists of a diverse group of employed individuals in South Africa. This sampling frame was selected as workload is assumed to occur in individuals who are working. The first set of respondents

included subject matter experts who were selected to evaluate the initial set of items generated and to determine the content validity.

Organisations were selected for participation based on their possession of a diverse workforce from a broad range of occupations. The study eventually included two organisations, each of which consisted of a broad range of departments, including human resources, finances and marketing. The first organisation specialises in motor vehicle insurance, while the second organisation operates in the engineering environment.

The unit of analysis for this study was therefore employed individuals from the South African population. The sources of data were the diverse workforce of South African organisations.

3.3.1.2.2 The sampling design

A non-probability sampling was chosen. According to Saunders et al. (2007) non-probability sampling involves a situation in which the probability of each case being selected from the total population is unknown. Non-probability sampling was selected for this study because it was impossible to determine the probability of each case being selected for inclusion in the sample.

The type of non-probability sampling used is referred to as heterogeneity sampling and is a type of purposive sampling. Purposive sampling implies sampling with a specific purpose. In this case the purpose was to develop a questionnaire that measures workload for the South African population. Heterogeneity sampling involves obtaining data from a wide range of diverse individuals and allows for the collection of data about the key themes (Saunders et al., 2007).

In addition to the heterogeneity sampling the study also made use of quota sampling. This sampling technique provides the opportunity of gathering data from a wide variety of individuals. Quota sampling allowed for the generation of additional data and ensured that the sample size was sufficiently large.

The rationale for the sampling method is discussed in the section below. The population from which the data was obtained included all employed individuals at different organisations in South Africa. The population was easily accessible to the researcher and individuals within the selected organizations had an equal opportunity of being selected for the survey. This sampling strategy resulted in the creation of a somewhat representative sample that increased the population validity.

3.3.1.3.3 Sample size

Leedy and Ormrod (2005) highlight the following factors for consideration when selecting a sample:

- The larger the population, the smaller the percentage required to have a representative sample size; and
- The heterogeneous nature of the sample, the more heterogeneous a sample is the larger the sample size needs to be.

According to DeVellis (1991, p. 80):

> "The rule of thumb on scale development is that approximately 300 responses are required to factorise items successfully. However, to be considered is if the items in the questionnaire are divided into sub-scales the responses could be less than 300 (5 responses per item)".

The proposed workload questionnaire consisted of a total of 43 items, and therefore the minimum number or responses required was 215 (43 x 5). The assumption was that the majority of approached individuals would be willing to participate and that quota sampling would serve as a back-up technique. This approach ensured that enough data was collected for statistical analysis and that the sample was fairly representative. Given considerations such as time constraint, costs and expertise this sampling method and sample size were considered the most suitable.

3.4 SURVEY METHODS

A questionnaire design was chosen as it works best with standardised questions that respondents' interpret in the same manner (Saunders et al., 2007). Questionnaires differ in terms of how they are administered and the level of contact between researcher and participants. In this study the questionnaires were self-administered and were delivered to the participants by hand (Saunders et al., 2007)

Saunders et al. (2007) state that the choice of questionnaire should be related to the research objectives and specifically to:

- Respondent characteristics.
- Importance of contact with respondent.
- Importance of uncontaminated data and
- Size of sample and the probable response rate.

This study measured employed individuals' subjective experiences of workload. Thus, contact with the respondents was not a critical factor. The study aimed to obtain objective scientific knowledge and in order to avoid the influence of the researchers' background, culture and history, contact with respondents was minimised. The size of the sample had to be large in order to be representative and due to time constraints easy and inexpensive access was necessary. The scale contained standardised items and therefore standardised responses were assumed.

The measurement tool measured workload and workload dimensions. The questionnaire allowed the respondents to remain anonymous and all responses were treated as confidentiality. Anonymity is believed to increase respondents' honesty and eliminate researcher bias based on personal information. The questionnaire did have a time limit and the recommended time for completion was 15 to 30 minutes (Worthington & Whittaker, 2006). The pilot study revealed that the majority of respondents took approximately 10 minutes to complete the questionnaire. The questionnaire was an inexpensive, time saving tool that was appropriate for the research purposes.

The questionnaire consisted of closed-ended items, because analysis time and resources for open-ended questions were limited. The use of closed-ended questions is a possible disadvantage and limitation of the study. The rationale for using closed-ended questions was that the anticipated number of responses was large and would therefore involve a large amount of qualitative analysis that was not possible given the research confines of this study. The use of closed-ended questions was deemed suitable for the descriptive and exploratory purposes of this study.

The questionnaire included a rating scale for responses. Welman et al. (2005) describe a rating scale as a situation where a rater evaluates the behaviour of the participants. A rating scale can take various forms but usually consists of a number of items, each of which must be answered on a scale range (Welman et al., 2005). The rater's aim is to place each participant in such a way that the participant's position in terms of the item is reflected (Welman et al., 2005). The use of rating scales is subject to the following rating errors:

- *The Central Tendency effect:* Respondents who do not want to assign extreme ratings rate items in the center.
- *The Logical error:* Participants provide similar ratings for questions that are logically related.
- *The Proximity error:* The participants' tendency to rate attributes that are close to each other as similar on the rating scale.
- *The Acquiescent Response set:* The participant is reluctant to give negative answers and rates all aspects positively (Welman et al., 2005).

A consent form was drawn up and participants were required to give consent before participating in the study. The consent form contained information relating to ethical issues such as participants' rights and confidentiality. The participants were also provided with an information sheet containing information relating to the study. Participants were asked to complete the questionnaire within a specific time frame and to submit the questionnaire once it was completed. The researcher followed up with participants regarding their submissions and responses. Biographical data was obtained by means of a categorical

response format. Participants were asked to choose only one option in terms of age, gender, race, employment sector and years working.

This data collection procedure had the following strengths:

- Data collection is not time-consuming;
- Anonymity and confidentiality is ensured;
- A suitable response rate can be assumed;
- The researcher is an objective outsider and influence on respondents is eliminated; and
- Standardised responses.

The rationale for this study and the resources available made the questionnaire the most suitable method for data collection. This format provided sufficient data to attain the goals and research objectives of the study.

3.4.1 Scale development

Scale development is defined as the construction of items relating to a particular construct (workload) in order to develop a measurement for that construct. Scale development involves four steps: item generation, questionnaire administration, item reduction and factor structure and determination of convergent and discriminant validity (Hinkin, 1998). During the scale development process subject matter experts were consulted to ensure content validity. Existing workload measurements were also consulted. These measures included the NASA-TLX, which is a rating procedure that is multidimensional and provides a score of the overall workload based on six subscales (Hart & Staveland, 1988) and the SWAT.

3.4.1.1 Item generation

Scale development begins with the creation of items to assess the target construct (Hinkin, 1998). The objective of this phase of the current study was to create items that measure workload. A deductive approach was used for item generation. Thus, an understanding of workload and recent literature applicable to workload was used to develop a theoretical definition of workload (Hinkin, 1998). The deductive approach assures content validity and captures the spectrum of knowledge surrounding the construct.

3.4.1.2 Item development

According to Hinkin (1998), item development must adhere to the following guidelines:

- Statements should be concise;
- The language should be appropriate for the audience;
- Items should focus on a single-issue, avoid leading questions; and
- Wording should not be negative.

These guidelines were adhered to during the item development phase.

3.4.1.3 Number of Items

The measure should be short and efficient (Hinkin, 1998). This normally involves the retaining of four to six items per construct (Hinkin, 1998).

3.4.1.4 Assessment of Content Validity

Worthington and Whittaker (2006) suggest that items be reviewed by groups of knowledgeable individuals in order to ensure that the items reflect the content. This process serves as a pre-test and eliminates items that do not reflect the content. Having experts review the items can either confirm or invalidate the phenomenon (Van der Westhuizen, 2008). In this study an expert was consulted during the initial development phase. Once the measure had been developed a panel of four subject matter experts was

consulted in order to determine the content validity of the workload measure. Lawshe's (1975) approach was used to determine the content validity ratio of each item. This approach determines whether an item is essential in terms of the factor being measured.

3.4.1.5 Item scaling

Hinkin (1998) states scaling should generate variance among respondents. A Likert-type scale is most frequently used in survey questionnaire research (Cook, Hepworth, & Warr, 1981; Kerlinger, 1986). A Likert-type scale consists of five equal intervals with a neutral point in the middle. A common example of a Likert-type scale is the item response options of strongly agree, agree, neither agree nor disagree, disagree and strongly disagree (Hinkin, 1998).

Once the items were finalised the next phase of the study involved conducting a pilot study.

3.4.1.6 Pilot study

DeVellis (1999) proposes the "inclusion of the validated items in the questionnaire that are forwarded to a sample of subjects preferably a representative sample of the population" (p. 54). The means that the items should be presented to a sample of the population in order to determine whether the items confirm the psychometric properties (workload dimensions) of the new measure (Hinkin, 1998).

The questionnaire was tested on a pilot sample prior to real administration. The aim of a pilot test is to refine the questionnaire so that participants experience no difficulties in answering the questions and no obstacles exist for data recording (Saunders et al., 2007). This ensures that the questionnaire is user-friendly and that quality data is generated.

Items developed during item generation were presented to a convenience sample. This sample was asked to examine the items and determine how well the items represent the construct. Additional information was obtained by providing pilot-test respondents with a further short questionnaire regarding:

- The time spent for questionnaire completion;
- The ease with which the instructions were understood;
- The clarity of the questions;
- Items or dimensions that seemed incomplete;
- The user-friendliness of the questionnaire; and
- Any other helpful comments (Saunders et al., 2007)

The initial questionnaire was administered to a small sample of 11 knowledgeable experts within the psychology field. This initial questionnaire contained 71 items. Lawshe's (1975) approach was applied following the results of the pilot study and the questionnaire was shortened to 43 items.

When developing a psychometric instrument several independent samples need to be utilised (Hinkin, 1998). In the pre-test where content validity needs to be determined small samples are suggested (Anderson & Gerbing, 1998; Schriesheim, Powers, Scandura, Gardiner & Lankau, 1993). According to Hinkin (1998) item-response ratios range from 1:4 (Rummel, 1970 cited in Hinkin, 1998) to 1:10 (Schwab, 1980 cited in Hinkin, 1998) for every factor to be analysed. Small sample sizes can be problematic as they limit the researcher's ability to make generalisations and can lead to high rates of variance in the responses.

3.4.1.7 Data collection instrument

3.4.1.7.1 Description

This phase involves the use of the items to measure the target construct (Hinkin, 1998). The items are presented to a representative sample of the population in order to examine the measure's psychometric properties (Hinkin, 1998). In this study participants rated a list of items on the basis of their compatibility with the construct (workload).

3.4.1.7.2 Administration

The South African Workload Scale questionnaire was handed to respondents in a hard copy format. Saunders et al., (2007) stresses the importance of having a clear agenda that identifies the tasks to be done and the resources required. If quality responses are to be obtained respondents must be enthusiastic about completing the questionnaire.

In the current study the following data collection agenda was followed:

- A pre-survey contact was made in order to inform respondents to expect a questionnaire.
- A covering letter accompanied the questionnaire to ensure that respondents were aware of the relevance and necessity of the study.
- The first follow-up was conducted one week after questionnaire distribution to remind non-respondents about the questionnaire and to thank early respondents.
- The second follow-up was conducted two weeks after questionnaire distribution to remind non-respondents to complete the questionnaire.
- The response rate was insufficient and quota sampling was followed (Saunders et al., 2007)

3.4.1.7.3 The scale

The scale must generate a sufficient amount of variance among the respondents (Hinkin, 1998). During the statistical analysis the data was checked for variance by evaluating the eigenvalues and the distribution of the data.

3.4.1.8 Data Analysis

Quantitative data in its unrefined form has very little academic or practical significance (Saunders et al., 2007). In order to be meaningful data must be processed and analysed. Data processing usually involves techniques such as statistics, charts and graphs. These

techniques are all designed to assist researchers' in exploring, presenting, describing and examining trends and relationships within the data set (Saunders et al., 2007).

The study aimed to develop a scale that measures workload for the South African population. Various methods exist to determine the validity of scales. Foxcroft and Roodt (2005) identify the following common methods of ensuring validity:

- Correlations between a new measure and an earlier measure;
- Factorial analysis that explores the interrelationships between variables;
- Demonstrating that the scores between groups differ in terms of a specific characteristic; and
- Conducting an analysis of the requirements of the items and determining whether these requirements are consistent with the underlying theory.

These methods are all suitable for determining test validity and the use of several methods increases users' confidence in the construct validity of the test. An exploratory factor analysis was conducted to determine the construct validity of the measure used in this study.

3.4.1.8.1 Descriptive statistics

According to Saunders et al. (2007), descriptive statistics allow researchers' to describe (and compare) variables. Descriptive statistics usually focus on central tendency and dispersion.

Table 3.4. Descriptive Statistics: Workload Inventory

Measure	Statistic
1. Central Tendency: :	
Represents the value that occurs the most frequent	Mode
Represents the middle value	Median
Represents the average	Mean
2. Dispersion:	

States the difference between lowest and highest value	Range
States difference between the middle 50% of values	Inter-quartile range
Describes the extent to which data values differ from the mean	Variance, Standard Deviation
Compares the extent to which data values differ	Coefficient of variation

Note: From *Research Methods for Business Students*. (4th ed), by M. Saunders et al. (2007). Harlow, Essex: Pearson Education.

3.4.1.8.2 Item analysis

In this step items are evaluated to determine which items should be retained and which items should be left out. Item Analysis is defined as the process that explores participants' responses to individual test items in order to assess the quality of these items and of the test as a whole (Office of Educational Assessment, 2005). In terms of the workload inventory item analysis helped to determine the quality of the items based on respondents' responses. Item analysis allows the researcher to improve test items, eliminate vague items, improve test construction skills and identify items that require clarification (Office of Educational Assessment, 2005).

Item analysis was used to determine the compatibility of the items with the constructs of the workload scale. Item statistics include item-total correlations, item means, item variances and item bias (Van de Vijver & Leung, 1997). Ideally the average score on a measure would be indistinguishable across different cultural groups. If this is not the case then an analysis of variance and the item response theory can be used to detect item bias (Van de Vijver & Leung, 1997).

Item statistics can detect poor item conversion. In the current study items that were found to be biased were eliminated in order to improve the validity and credibility of the scale (Van de Vijver & Leung, 1997). The conducting on an item analysis is thus an important part of the development of a psychometric scale.

3.4.1.8.3 Factor analysis

Many researchers assert that factor analysis is one of the most valuable statistical approaches for demonstrating the validity and structure of measures of affect, perception, constructs and opinions (Froman, 2001). Factor analysis is used to refine newly developed scales (Hinkin, 1998).

3.4.1.8.4 Exploratory Factor Analysis

Factor analysis involves reducing a set of variables to a smaller set of variables and is important in the development of construct validity (Hinkin, 1998). The number of factors to be retained is determined by the theory as well as the results (Hinkin, 1998). The first step in the factor analysis process involves a systematic process of analysing the interrelationships among the items of the scale. This systemic process indicates clusters of items that justify the grouping of items into a factor that represents latent constructs (Froman, 2001). A one-dimensional set of constructs results in a single grouping of factors that cluster together while constructs that are multidimensional will not cluster together (Froman, 2001). The findings in this study were contradictory and did not support the construct validity of the scale for workload inventory.

According to Van der Westhuizen (2008) making a decision regarding the number of factors to extract can be a rather difficult task. The following guidelines should be considered (Van der Westhuizen, 2008):

- *Kaiser – Guttman Rule*
  The eigenvalues greater than one rule states that the number of factors to be extracted should be equal to the number of factors with an eigenvalue (variance) greater than 1.0.
- *Scree Test*

Plotting the eigenvalues against the factor numbers also provides an indication of the number of factors to extract. Specifically, the 'elbow', or point at which the curve bends, is an indication of the maximum number of factors to extract.

- *Interpretability*
  The factors should also be evaluated based on the theoretical meaningfulness of a particular factor.
- *Factor Rotation*
  Once the factors are extracted they need to be rotated. The simplest case of rotation is orthogonal rotation where the angle between the reference axes of factors is maintained at 90 degrees.

Some statistics relating to factor analysis are also important in terms of data analysis. The first aspect that must be addressed is the correctness of the sample size. Ideally, factor analysis requires 10-15 participants per variable (Field, 2005).

According to Field (2005), R-factor analysis allows the researcher to verify the latent factors and group the different test questions. In order to determine data fit a number of correlations should be > 0, 30. Methods to determine data fit include the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity (Field, 2005).

Once the factor analysis has resulted in a factor loadings matrix the interpretation of the factors can begin. According to Field (2005), significant loadings should be emphasised and can be determined in two ways: (1) practical significance and (2) statistical significance. Practical significance helps researchers verify whether the factor loadings are big enough to have a significant effect on variables. 0.30 is considered a minimal effect, 0.40 a slight effect and 0.50 is practically significant (Field, 2005). Statistical significance refers to a factor loading that is statistically significantly different to zero (Field, 2005).

According to Stevens (2003) the rules of thumb for statistical significance are based on sample size. These levels of statistical significance are in table 3.5.

Table 3.5: Statistical Significance

Sample Size (n)	50	100	200	300	600	1000
Loading	0,722	0,512	0,384	0,298	0,210	0,162

Note: From *Applied Multivariate Statistics for the Social Sciences* (4th ed), p. 294 by J. Stevens (2003). Mahwah, N.J: Lawrence Erlbaum Associates.

3.4.1.8.5 Internal Consistency Assessment

The measure must also be reliable. Reliability is determined the internal consistency, which is calculated using Cronbachs' alpha (Hinkin, 1998). According to Foxcroft and Roodt (2005), an instrument is reliable when it correlates highly with other variables with which it should hypothetically correlate and correlates modestly with variables from which it should hypothetically differ. An instrument that correlates well with variables to which it is theoretically related displays good convergent validity while an instrument that correlates modestly to variables with which it is not theoretically related displays good discriminant validity (Foxcroft & Roodt, 2005).

Convergent validity is determined by the correlation among the items and is referred to as internal consistency (Foxcroft & Roodt, 2005). Internal consistency serves to moderate correlation; if the correlation is poor and inadequate the instrument requires more factors. Cronbach's alpha is used to determine and interpret internal consistency. A construct validity of 0.6 is considered acceptable for exploratory purposes, 0.7 is considered appropriate for confirmatory purposes and 0.8 is considered good for confirmatory purposes (Field, 2005).

3.5 CONCLUSION

The chapter emphasised the difficulties involved in the data collection and analysis. The research methodology and design was clarified and the composition and relevance of the questionnaire used for data collection was explained. The different statistical analysis techniques used in the research were also addressed. The limitations and difficulties of the study were recognised and addressed as far as possible.

Chapter 4 depicts the application and explanation of the item and factor analysis performed on the data.

CHAPTER 4

Data Analysis and Interpretation

"There are no facts, only interpretations"

Friedrich Nietzsche 1844-1900

4.1 INTRODUCTION

Chapter three discussed the research methodology, steps and rationale and concluded with an introductory description of the methodology and statistical measures used for the analysis of the data. In this chapter the results are presented and interpreted in accordance with the measures outlined in chapter 3.

The empirical phase of this study aimed to provide data that could provide some insight and direction regarding the research objectives outlined in chapter 1. These research objectives included defining and understanding, by means of a comprehensive literature review, the various dimensions of the workload construct. These definitions provided the foundation for compiling a comprehensive framework that served as the starting point for the scale development process.

The primary objective of the research was to develop a workload measure based on the framework established. This objective consisted of two specific aims:

- Develop a scale that measures all facets of workload.
- Generate items that measure workload in the South African organisation.

The secondary objective of the study involved enhancing the understanding of the concept of workload and the factors that constitute the scope of workload within South African organisations.

The empirical study began with the evaluation and verification of the content validity by the identified subject matter experts.

4.2 RESULTS AND FINDINGS

The empirical process, statistical analysis, results and findings involved the following four phases.

- Phase 1: Steps and process of item generation for the South African Workload Scale (SAWS);
- Phase 2: Evaluation and verification of the content validity of the South African Workload Scale (SAWS);
- Phase 3: The scale development of the South African Workload Scale (SAWS);
- Phase 4: Conducting the testing of the SAWS to establish its reliability and validity for South African organisations.

4.2.1 Item generation of the South African workload scale (saws)

The process of item generation for the SAWS included several steps, each of which is explained and described below. The literature supporting each step has been extensively documented in chapter 2 (Literature study).

- **Step 1: Analysis of the different facets of workload**

Workload is a complex concept that includes many facets. The literature emphasises the following facets (see chapter 2):

1.) *Workload as a function of demand and supply:* Workload is generally defined as the extent of processing capacity that is expended during the performance of a task. Workload is thus concerned with the interaction between resource supply and task demand (Young et al., 2008).

2.) *Workload as a function of capacity:* Workload is conceptualised in terms of the interaction between the task demands and the capacity of the human operator. O'Donnell and Eggemeier (1986) define workload in relation to the human operator's capacity to perform a specific task.

3.) *Workload as an experienced load:* This facet of workload shifts the emphasis from a task-specific definition to a more person-specific definition of workload. Kruger (2005) states that an operator's capabilities, motivation, task performance strategies and mood all influence the experienced workload.

4.) *Workload in terms of the time load:* Meister (1971) indicates that tasks have to be completed in a certain time. Human operators only have a certain amount of time available for a particular task.

- **Step 2: An operational definition of workload**

The concept of workload is complex and multifaceted. Based on the literature study the study proposed an operational definition of workload that was designed to include the different interdependent dimensions underlying the overall workload construct. In the operational definition workload is seen as consisting of four different components, which each need to be evaluated in order to measure workload. The four dimensions are:

1.) *Input Load – Task Demands:* The input load includes: the amount of tasks, the concentration level required, temporal demand (time load), environmental and situational factors, and ergonomics and work design.

2.) *Capacity – Resources available:* Resources or capacity refers to the abilities and support of the human operator. This includes factors such as experienced load, coping mechanisms, support mechanisms, knowledge, skills, training, stress, fatigue and boredom.

3.) *Operator Performance:* The performance of the operator includes quality and accuracy of work and performance standards.

4.) *Output:* The output refers to the outcome or result of the workload. Output can involve mental demand, physical demand and the perception of the workload.

- **Step 3: Analysis of current subjective workload measures**

  There are instruments available to measure workload. These instruments were extensively reviewed in chapter 2 in order to determine their effectiveness. A measure's reliability and validity were the biggest determining factors in utilising the measurement's content to generate items. The following measurements were the most important:

1.) The Modified Cooper-Harper (MC-H) Scale;
2.) The Bedford Scale;
3.) The Subjective Workload Assessment Technique (SWAT);
4.) The NASA Task Load Index (NASA-TLX); and
5.) The Workload Profile (WP).

- **Step 4: Item generation**

The literature created a sound theoretical foundation for the generation of items that reflect the different dimensions of workload. A set of items was then generated that covered all the domains of workload. Table 4.1 provides a list of these items along with their dimensions, descriptive elements and source/theoretical foundation.

Table 4.1. Item Generation

Initial Item Generated	**Source / Theoretical Foundation**
Factor A: Mental Demand	
1. I have tasks that require thinking.	Hart and Staveland (1988, p. 240) define mental effort as: "the amount of mental and/or perceptual activity that was required (e.g. **Thinking**, deciding, calculating, remembering, looking, searching, etc.)."
2. I have to make decisions during task execution.	Hart and Staveland (1988, p. 240) define mental effort as: "The amount of mental and/or perceptual activity that was required (e.g. Thinking, **deciding**, calculating, remembering,

	looking, searching, etc.)”
3. I am required to make calculations while performing my tasks.	Hart and Staveland (1988, p. 240) define mental effort as: “The amount of mental and/or perceptual activity that was required (e.g. Thinking, deciding, **calculating**, remembering, looking, searching, etc.)?”
4. During task execution I am expected to recall information.	Hart and Staveland (1988, p. 240) define mental effort as: “The amount of mental and/or perceptual activity that was required (e.g. Thinking, deciding, calculating, **remembering**, looking, searching, etc.)?”
5. I am required to gather information for tasks.	Hart and Staveland (1988, p. 240) define mental effort as: “The amount of mental and/or perceptual activity that was required (e.g. Thinking, deciding, calculating, remembering, looking, searching, etc.)” Information gathering is a necessary component of decision-making.
6. I have to draw conclusions when conducting tasks.	Hart and Staveland (1988, p. 240) define mental effort as: “The amount of mental and/or perceptual activity that was required (e.g. Thinking, deciding, calculating, remembering, looking, searching, etc.)” The rationale is that mental activity includes drawing conclusions, as this is a cognitive function.
7. I feel that my tasks are easy.	Hart and Staveland (1988, p. 240) describe mental task difficulty as: “Whether the task was **easy** or demanding, simple or complex, exacting or forgiving.”
8. I am of the opinion that my tasks are simple.	Hart and Staveland (1988, p. 240) describe mental task difficulty as: “Whether the task was easy or demanding, **simple** or complex, exacting or forgiving.”
9. I am of the opinion that my tasks are demanding.	Hart and Staveland (1988, p. 240) describe mental task difficulty as: “Whether the task was easy or **demanding**, simple or complex,

	exacting or forgiving."
10. I feel that my tasks are complex.	Hart and Staveland (1988, p. 240) describe mental task difficulty as: "Whether the task was easy or demanding, simple or **complex**, exacting or forgiving."
11. I have tasks that require the analysis of information.	Hart and Staveland (1988, p. 240) define mental effort as: "The amount of mental and/or perceptual activity that was required (e.g. Thinking, deciding, calculating, remembering, looking, searching, etc.)."
12. I am of the opinion that my tasks require prioritising.	Hart and Staveland (1988, p. 240) define mental effort as: "The amount of mental and/or perceptual activity that was required (e.g. Thinking, deciding, calculating, remembering, looking, searching, etc.)." Prioritising is assumed to be a mental activity.
13. My tasks are automated.	Hart and Staveland (1988, p. 240) define mental effort as: "The amount of mental and/or perceptual activity that was required (e.g. Thinking, deciding, calculating, remembering, looking, searching, etc.)." Automated tasks require limited mental activity.
14. I am of the opinion that my tasks require concentration.	Hart and Staveland (1988, p. 240) define mental effort as: "The amount of mental and/or perceptual activity that was required (e.g. Thinking, deciding, calculating, remembering, looking, searching, etc.)." The rationale is that concentration is a cognitive/mental activity.
15. I have tasks that necessitate the use of my judgement.	Hart and Staveland (1988, p. 240) define mental effort as: "The amount of mental and/or perceptual activity that was required (e.g. Thinking, deciding, calculating, remembering, looking, searching, etc.)."
Factor B: Physical Demand	
16. I have tasks that require physically	Hart and Staveland (1988, p. 240) state that

pushing objects.	physical effort includes: “The amount of physical activity that was required (e.g. **pushing**, pulling, turning, controlling, activating, etc.).”
17. My tasks are tough and physically challenging.	Hart and Staveland (1988, p. 240) state that physical effort includes: “The amount of physical activity that was required.” The assumption is that physically challenging tasks will impact on the operators’ workload.
18. During task execution I am expected to physically turn objects.	Hart and Staveland (1988, p. 240) state that physical effort includes: “The amount of physical activity that was required (e.g. pushing, pulling, **turning**, controlling, activating, etc.).”
19. I am of the opinion tasks require controlling objects.	Hart and Staveland (1988, p. 240) state that physical effort includes: “The amount of physical activity that was required (e.g. pushing, pulling, turning, **controlling**, activating, etc.).”
20. My tasks necessitate walking.	The amount of physical activity that was required to perform the task can include walking (Hart & Staveland, 1988).
21. I have tasks that require moving objects.	Hart and Staveland (1988, p. 240) state that physical effort includes: “The amount of physical activity that was required (e.g. pushing, pulling, turning, controlling, activating, etc.).”
22. I feel that my tasks are physically easy.	Hart and Staveland (1988, p. 240) state that physical task difficulty can be defined as: “Whether the task was **easy** or demanding, simple or complex, exacting or forgiving”.
23. I am of the opinion that my tasks are physically difficult.	Hart and Staveland (1988, p. 240) state that physical task difficulty can be defined as: “Whether the task was easy or demanding, simple or complex, exacting or forgiving”. The

	assumption is that difficult tasks are the opposite of easy tasks.
24. My tasks require slow bodily actions.	This relates to the amount of physical activity that was required as well as the pace of physical activity (Hart & Staveland, 1988).
25. My tasks are physically relaxing.	Hart and Staveland (1988, p. 240) state that physical demand includes: "The amount of physical activity that was required". The rationale is that limited physical activity results in relaxing physical demand.
26. My tasks are rapid and high-speed actions.	This refers to the amount of physical activity required and is thus related to actions (Hart & Staveland, 1988).
27. I am of the opinion that my tasks are physically restful.	Hart and Staveland (1988, p. 240) state that physical demand includes: "The amount of physical activity that was required". Limited physical activity is likely to result in relaxing physical demand.
28. I am required to use equipment and or machinery during task execution.	Hart and Staveland (1988, p. 240) state that physical effort includes: "The amount of physical activity that was required (e.g. pushing, pulling, turning, controlling, activating, etc.)."
29. I feel physically tired after task execution.	This item refers to the quantity of physical action that was required (Hart & Staveland, 1988).
30. I have tasks that require physically pulling objects.	Hart and Staveland (1988, p. 240) state that physical effort includes: "The amount of physical activity that was required (e.g. pushing, **pulling**, turning, controlling, activating, etc.)."
Factor C: Temporal Demand	
31. I have tasks that provide for spare time often.	According to Wickens and Holland (2000) the time load factor includes often having spare time.

32. I am of the opinion that my tasks provide for spare time occasionally.	According to Wickens and Holland (2000) the time load factor includes occasionally having spare time.
33. I feel that my tasks almost never make provision for spare time.	According to Wickens and Holland (2000) the time load factor includes rarely or almost never having spare time.
34. My tasks occur at a rapid pace creating time pressures.	According to Hart and Staveland (1988), temporal load refers to the amount of pressure experienced due to the rate at which the task occurred.
35. I am confident that my tasks occur at a slow pace.	According to Hart and Staveland (1988), temporal load refers to the amount of pressure experienced due to the rate at which the task occurred.
36. I feel that my tasks take place at my time.	According to Hart and Staveland (1988), temporal load refers to the amount of pressure experienced due to the rate at which the task occurred.
37. During task execution, I have to adhere to strict deadlines.	According to Hart and Staveland (1988), temporal load refers to the amount of pressure experienced due to the rate at which the task occurred. The rationale is that strict deadlines create time pressure.
38. My tasks need to be completed in a certain time.	According to Hart and Staveland (1988), temporal load refers to the amount of pressure experienced due to the rate at which the task occurred.
39. My task deadlines are flexible.	According to Hart and Staveland (1988), temporal load refers to the amount of pressure experienced due to the rate at which the task occurred.
40. I am of the opinion that my tasks do not create time pressures.	According to Hart and Staveland (1988), the time pressure associated with a specific task can be assessed by asking: “Was the rate slow and leisurely or rapid and frantic?”

Factor D: Performance	
41. I am confident that I achieve my task goals.	Performance refers to subjective feelings of success in relation to the goals of the task (Hart & Staveland, 1988).
42. I feel that my task completion contribute to the organisation's success.	Performance refers to subjective feelings of success in relation to the goals of the task (Hart & Staveland, 1988). The reasoning is that individuals who feel successful will perceive organisational success.
43. The execution of my tasks demonstrates the mastery of the skills required for my tasks.	Performance refers to subjective feelings of success in relation to **achieving** the goals of the task (Hart & Staveland, 1988).
44. I know that I meet job performance standards in all or most tasks.	Hart and Staveland (1988) suggest that performance is related to satisfaction performance on individual goals.
45. My work results are inconsistent.	The perception of performance influences the operators' workload (Hart & Staveland, 1988).
46. I feel that I do not achieve task goals.	Performance refers to subjective feelings of success in relation to achieving the goals of the task (Hart & Staveland, 1988).
47. I know that I do not demonstrate the ability to perform my tasks.	The perception of performance influences the operators' workload (Hart & Staveland, 1988).
48. I am successful in meeting performance standards.	Performance refers to subjective feelings of success in relation to the goals of the task (Hart & Staveland, 1988).
49. My tasks are done and completed on schedule.	The perception of performance influences the operators' workload (Hart and Staveland, 1988).
50. I am of the opinion that I require a written performance improvement plan.	Performance refers to a subjective feeling of success in relation to the goals of the task (Hart & Staveland, 1988). Individuals who view themselves as successful will not require a performance plan.
Factor E: Effort	
51. I feel that my tasks require a high level of	According to Hart and Staveland (1988) effort

intensity.	is related to the level of work (mentally and physically) that was required to achieve the performance.
52. I am of the opinion that I put in a lot of effort to execute tasks.	According to Hart and Staveland (1988) effort measures workload.
53. My tasks are not intense.	According to Hart and Staveland (1988) effort is related to the level of work (mentally and physically) that was required to achieve the performance.
54. During tasks I do not put in any efforts to execute tasks.	According to Hart and Staveland (1988) effort measures workload.
55. I am of the opinion that my tasks require a limited level of intensity.	According to Hart and Staveland (1988) effort is related to the level of work (mentally and physically) that was required to achieve the performance.In this case a low level of intensity is required.
56. I put in a small amount of effort to conduct tasks.	According to Hart and Staveland (1988) effort measures workload.
Factor F: Frustration Level	
57. I have tasks that make me feel insecure.	Hart and Staveland (1988, p. 240) state that frustration can be measured by asking: “How **insecure**, discouraged, irritated, stressed and annoyed versus secure, gratified, content, relaxed and complacent did you feel during the task?” (Hart & Staveland, 1988).
58. My tasks make me feel discouraged.	Hart and Staveland (1988, p. 240) state that frustration can be measured by asking: “How insecure, **discouraged**, irritated, stressed and annoyed versus secure, gratified, content, relaxed and complacent did you feel during the task?”
59. During task execution I am irritated.	Hart and Staveland (1988, p. 240) state that frustration can be measured by asking: “How insecure, discouraged, **irritated**, stressed and annoyed versus secure, gratified, content,

	relaxed and complacent did you feel during the task?"
60. I feel stressed when completing tasks.	Hart and Staveland (1988, p. 240) state that frustration can be measured by asking: "How insecure, discouraged, irritated, **stressed** and annoyed versus secure, gratified, content, relaxed and complacent did you feel during the task?"
61. My tasks make me feel annoyed.	Hart and Staveland (1988, p. 240) state that frustration can be measured by asking: "How insecure, discouraged, irritated, stressed and **annoyed** versus secure, gratified, content, relaxed and complacent did you feel during the task?"
62. I have tasks that make me feel secure.	Hart and Staveland (1988, p. 240) state that frustration can be measured by asking: "How insecure, discouraged, irritated, stressed and annoyed versus **secure**, gratified, content, relaxed and complacent did you feel during the task?"
63. I feel gratified during task execution.	Hart and Staveland (1988, p. 240) state that frustration can be measured by asking: "How insecure, discouraged, irritated, stressed and annoyed versus secure, **gratified**, content, relaxed and complacent did you feel during the task?"
64. I am of the opinion that my tasks make me feel content.	Hart and Staveland (1988, p. 240) state that frustration can be measured by asking: "How insecure, discouraged, irritated, stressed and annoyed versus secure, gratified, **content**, relaxed and complacent did you feel during the task?"
65. I am confident that my tasks make me feel relaxed.	Hart and Staveland (1988, p. 240) state that frustration can be measured by asking: "How insecure, discouraged, irritated, stressed and

	annoyed versus secure, gratified, content, **relaxed** and complacent did you feel during the task?"
66. My tasks make me feel satisfied.	Hart and Staveland (1988, p. 240) state that frustration can be measured by asking: "How insecure, discouraged, irritated, stressed and annoyed versus secure, gratified, content, relaxed and **complacent** did you feel during the task?"
67. I have tasks that make me feel competent.	Hart and Staveland (1988, p. 240) state that frustration can be measured by asking: "How insecure, discouraged, irritated, stressed and annoyed versus secure, gratified, content, relaxed and complacent did you feel during the task?" The rationale is that operators feel competent when they are complacent.
68. My tasks make me feel incompetent.	Hart and Staveland (1988, p. 240) state that frustration can be measured by asking: "How insecure, discouraged, irritated, stressed and annoyed versus secure, gratified, content, relaxed and complacent did you feel during the task?" The argument is that an incompetent operator does not feel complacent.
69. My tasks are boring.	According to Hancock & Desmond (2001) jobs with minimal opportunity for control and personal influence are most often affected by stress. In other words individuals that conduct repetitive tasks with no decision making power (counting boxes) are most likely to experience stress. The argument is that boredom may result in work under load.
70. I am of the opinion that my tasks are exciting.	The assumption was made that if the operator is not frustrated she/he will experience excitement.
71. I feel helpless during task execution.	Hart and Staveland (1988, p. 240) state that

	frustration can be measured by asking: "How insecure, discouraged, irritated, stressed and annoyed versus secure, gratified, content, relaxed and complacent did you feel during the task?" The rationale is that frustration can be perceived as a feeling of helplessness.

4.2.2 Verification of the content validity of the South African workload scale

For the purposes of evaluation and verification of the content validity of the generated items, Lawshe's (1975) content validity ratio (CVR) was calculated. The items were developed based on a sound theoretical framework. The biographical information of the subject matter experts (SMEs) is displayed in table 4.2. The results of the content validity of the workload dimensions and descriptive items are shown in table 2.3.

Table 4.2. Biographical information on the subject matter expert group (N = 4)

Years work experience in applied psychology or related field			
	Frequency	**Valid %**	**Cumulative %**
0-5 years	1	25%	25%
6-10 years	1	25%	50%
11-15 years	2	50%	100%
Total:	4	100%	100%
Age Distribution			
41-50 years	2	50%	50%
50+ years	2	50%	100%
Total:	4	100%	100%
Gender			
Male	2	50%	50%
Female	2	50%	100%
Total:	4	100%	100%
Ethnic Group			
Black	1	25%	25%

White	3	75%	100%
Total:	4	100%	100%
Highest Qualification			
Master's degree	3	75%	75%
Doctoral degree	1	25%	100%
Total:	4	100%	100%
Economic Sector			
Tertiary sector	2	50%	50%
Government	2	50%	100%
Total:	4	100%	100%

The relevance questionnaire had a response rate of four. All four questionnaires were unspoiled and could be used for analysis. The respondents all worked within the applied psychology field, with 50% of respondents working within the research and development discipline within applied psychology.

The respondents were all extremely well qualified and experienced. All of the respondents had a master's degree or higher qualification and 75% of the respondents had 6 years or more experience within applied psychology. The opinions of these experts were therefore very valuable to the study.

The purpose of the relevance questionnaire is to allow a panel of subject matter experts to indicate whether an item is essential to the measurement of a specific dimension. The subject matter experts' input is then used to calculate the Content Validity Ration (CVR) for each item as follows:

$$CVR\ i = \frac{ne - \left(\frac{N}{2}\right)}{\frac{N}{2}}$$

In this calculation: $CVR\ i$ = CVR value for the i^{th} measurement

ne = number of subject matter experts indicating that the item is 'essential' and

N = total number of subject matter experts on the panel.

The CVR is a quasi-quantitative approach to content validity that is generally used to retain or reject specific items. The CVR provides values between -1.0 (where none of the SMEs

consider the item essential) and +1.0 (where all the SMEs consider the item essential). A CVR of 0.00 indicates that 50% of the subject matter experts consider the item to be essential. Hence a CVR ≥ 0.0 indicates that more than half of the SMEs indicated that the specific item is essential in measuring the specific dimension. Therefore in this study items with a CVR value ≤0.5 were eliminated from the questionnaire unless there was a sound theoretical foundation for retaining the item.

Table 4.3. Content validity of workload dimensions and descriptive items

Initial Item	**Number of experts indicating that item is essential (ne)**	**Number of experts indicating that item need to be rephrased**	**Content Validity Ratio (CVR)**	**Retain item (Yes / No)**	**Revised Item**
1. I have tasks that require thinking.	4	0	1.00	Yes	I have tasks that require thinking.
2. I have to make decisions during task execution.	4	0	1.00	Yes	I have to make decisions when **carrying out** my tasks.
3. I am required to make calculations while performing my tasks.	4	0	1.00	Yes	I am required to make calculations while performing my tasks.
4. During task execution I am expected to recall information.	3	1	0.50	Yes	**Remembering information is important in the work that I do.**
5. I am required to gather information for tasks.	4	1	1.00	Yes	I am required to **collect** information for tasks.
6. I have to draw conclusions when conducting tasks.	4	0	1.00	Yes	I have to draw conclusions **in order to carry out** my tasks.
7. I feel that my tasks are easy.	3	1	0.50	Yes	**My tasks are easy.**
8. I am of the opinion that my tasks are simple.	4	0	1.00	Yes	**My tasks are straightforward.**
9. I am of the opinion that my tasks are demanding.	4	1	1.00	Yes	My tasks are **mentally** demanding.
10. I feel that my tasks are complex.	3	1	0.50	Yes	**My tasks are complex.**
11. I have tasks that require the analysis of	4	0	1.00	Yes	**I have tasks that require the analysis of information.**

information.					
12. I am of the opinion that my tasks require prioritising.	4	1	1.00	Yes	**Prioritising tasks is important for the work that I do.**
13. My tasks are automated.	3	1	0.50	Yes	**My tasks are routine.**
14. I am of the opinion that my tasks require concentration.	4	0	1.00	Yes	**Completing my tasks requires concentration.**
15. I have tasks that necessitate the use of my judgement.	4	0	1.00	Yes	**I have tasks that require me to use my judgements.**
16. I have tasks that require physically pushing objects.	2	0	0.00	Yes	**I have tasks that require physically moving large objects.**
17. My tasks are tough and physically challenging.	4	1	1.00	Yes	**My tasks are physically challenging.**
18. During task execution I am expected to physically turn objects.	1	1	-0.50	No	
19. I am of the opinion my tasks require controlling objects.	1	2	-0.50	No	
20. My tasks necessitate walking.	2	0	0.00	Yes	**Running or walking is an important part of my tasks.**
21. I have tasks that require moving objects.	4	0	1.00	No	
22. I feel that my tasks are physically easy.	3	1	0.50	Yes	**My tasks are physically easy.**
23. I am of the opinion that my tasks are physically difficult.	4	0	1.00	Yes	**My tasks are physically difficult.**
24. My tasks require slow bodily actions.	4	0	1.00	Yes	**My tasks require little physical activity.**
25. My tasks are physically relaxing.	4	1	1.00	Yes	**My tasks are physically stressful.**
26. My tasks are rapid and high-speed actions.	4	2	1.00	Yes	**My tasks involve fast physical action.**
27. I am of the opinion that my	3	3	0.50	Yes	**My tasks are more physical than mental.**

tasks are physically restful.					
28. I am required to use equipment and or machinery during task execution.	4	0	1.00	Yes	**My tasks involve making use of equipment.**
29. I feel physically tired after task execution.	4	0	1.00	Yes	**I feel physically tired after completing my tasks.**
30. I have tasks that require physically pulling objects.	2	2	0.00	Yes	**My tasks involve using heavy machinery.**
31. I have tasks that provide for spare time often.	4	2	1.00	Yes	**I have spare time during working hours.**
32. I am of the opinion that my tasks provide for spare time occasionally.	1	2	-0.50	Yes	**I work long hours.**
33. I feel that my tasks almost never make provision for spare time.	3	2	0.50	Yes	**I regularly have to work overtime.**
34. My tasks occur at a rapid pace creating time pressures.	4	1	1.00	Yes	**My tasks must be performed at a fast pace.**
35. I am confident that my tasks occur at a slow pace.	3	2	0.50	Yes	**My tasks are carried out at a slow pace.**
36. I feel that my tasks take place at my time.	4	1	1.00	Yes	**I can set my own work pace.**
37. During task execution I have to adhere to strict deadlines.	4	0	1.00	Yes	**My work requires me to adhere to strict deadlines.**
38. My tasks need to be completed in a certain time.	3	1	0.50	Yes	**My tasks need to be completed within a certain time limit.**
39. My task deadlines are flexible.	4	1	1.00	Yes	**I have enough time to complete my tasks.**
40. I am of the opinion that my tasks do not create time pressures.	3	1	0.50	Yes	**My tasks do not place time pressures on me.**
41. I am confident that I achieve my task	2	0	0.00	No	

goals.					
42. I feel that my task completion contribute to the organisation's success.	2	0	0.00	No	
43. The execution of my tasks demonstrates the mastery of the skills required for my tasks.	2	1	0.00	No	
44. I know that I meet job performance standards in all or most tasks.	2	0	0.00	No	
45. My work results are inconsistent.	2	0	0.00	No	
46. I feel that I do not achieve task goals.	2	0	0.00	No	
47. I know that I do not demonstrate the ability to perform my tasks.	2	0	0.00	No	
48. I am successful in meeting performance standards.	2	0	0.00	No	
49. My tasks are done and completed on schedule.	2	1	0.00	No	
50. I am of the opinion that I require a written performance improvement plan.	2	0	0.00	No	
51. I feel that my tasks require a high level of intensity.	2	0	0.00	No	
52. I am of the opinion that I put in a lot of effort to execute tasks.	2	0	0.00	No	
53. My tasks are not intense.	2	0	0.00	No	
54. During tasks I do not put in any efforts to execute tasks.	1	0	-0.50	No	

55. I am of the opinion that my tasks require a limited level of intensity.	1	1	-0.50	No	
56. I put in a little amount of effort to conduct tasks.	1	1	-0.50	No	
57. I have tasks that make me feel insecure.	4	0	1.00	Yes	I have tasks that make me feel **unsure of myself.**
58. My tasks make me feel discouraged.	4	1	1.00	Yes	My tasks **discourage me.**
59. During task execution I am irritated.	4	0	1.00	Yes	**My tasks cause me to feel irritated.**
60. I feel stressed when completing tasks.	4	0	1.00	Yes	**Carrying out my tasks causes me to feel stressed.**
61. My tasks make me feel annoyed.	4	0	1.00	Yes	**My tasks make me feel frustrated.**
62. I have tasks that make me feel secure.	3	1	0.50	Yes	Carrying out my tasks make me feel **good about myself.**
63. I feel gratified during task execution.	4	1	1.00	Yes	I **enjoy carrying out my tasks.**
64. I am of the opinion that my tasks make me feel content.	3	2	0.50	Yes	**I enjoy going to work.**
65. I am confident that my tasks make me feel relaxed.	3	2	0.50	Yes	**My tasks make me feel relaxed.**
66. My tasks make me feel satisfied.	4	0	1.00	Yes	My tasks make me feel satisfied.
67. I have tasks that make me feel competent.	3	2	0.50	Yes	**My tasks** make me feel competent.
68. My tasks make me feel incompetent.	4	0	1.00	Yes	I have tasks that cause me **to doubt my abilities.**
69. My tasks are boring.	4	0	1.00	Yes	My tasks are boring.
70. I am of the opinion that my tasks are exciting.	**2**	1	**0.00**	Yes	**My tasks are exciting.**
71. I feel helpless during task execution.	4	0	1.00	Yes	I feel helpless **when carrying out my tasks.**

The results indicated in table 4.3 provide evidence for the redundancy of the effort dimension, especially in relation to the other five dimensions (mental demand, physical demand, temporal demand, and performance and frustration level). This redundancy was anticipated as the items in the effort dimension overlapped with items in other dimensions. A decision was taken to exclude the effort dimension.

Five of the items deemed non-essential were still utilised in the final questionnaire. The first non-essential item that was included is “I have tasks that require physically pushing objects”. The rationale for keeping this item was based on Hart and Staveland’s (1988) research that argues that physical demand includes the amount of physical activity necessary, which includes pulling, pushing, controlling, regulation and activating. The item was however rephrased. The same logic applies to the third non-essential item that was retained: “I have tasks that require physically pulling objects”. The second non-essential item that was retained was: “My tasks necessitate walking.” This item forms part of Hart and Staveland’s (1988) argument regarding the importance of physical demand. The item was also rephrased. The fourth non-essential item that was retained stated: “I am of the opinion that my tasks provide for spare time occasionally”. This item was based on Hart and Staveland’s (1988) argument regarding the temporal demands associated with workload. The last non-essential item that was retained stated: “I am of the opinion that my tasks are exciting”. This item was placed under the frustration level factor as it was assumed that a frustrated employee would not be excited.

A total of 18 items were eliminated from the questionnaire based on the content validity ratio. However, the expert panel suggested the inclusion of the following items in order to make the questionnaire more complete:

- I have more work than I can do in a day.
- My work requires specialised skills.
- My tasks require a high degree of accuracy.
- Quality is important in my work.
- The performance standards required for my tasks are achievable.

- Clear performance standards are set for my tasks.
- High performance standards are required for my tasks.
- I find it difficult to perform my tasks.
- I meet performance standards.

In summary, an initial set of six dimensions with 71 items was generated. These items were then sent to subject matter experts in order to determine the content validity of the South African Workload Scale (SAWS) and to provide experts with the opportunity to make the questionnaire more comprehensive. During this phase 52 items were retained and a total of 9 items were added based on the experts' suggestions. Therefore, a total number of 61 items was used for the pilot study.

The pilot study was conducted with the 61 items and was completed by 11 knowledgeable individuals within the psychology discipline. The pilot study's data was used to determine the reliability of the different dimensions and their descriptive items. Following the pilot study it was determined that including a total of only 43 items would optimise the scale and increase the probability of a reliable workload measure. The final questionnaire was then given to the same subject matter experts for final review. Only three of the experts were available at that particular point in time. The three experts commented that the measure was ready and acceptable for data collection. The item generation and the content validity phases are presented graphically in figure 4.1.

Figure 4.1: Items of South African Workload Scale (SAWS)

4.2.3 The South African Workload Scale (SAWS) – scale development

The items validated during the content validity process were included in the South African Workload Scale (SAWS) (included as annexure B). The questionnaire was distributed within two organisations. The organisations consisted of different departments including human resources, finances, marketing, logistics, and sales departments. The sample group is fairly representative of different industrial sectors such as financial services, insurance, engineering, government and professional services.

The sample group's biographical information is described in table 4.3. 224 employed individuals completed the questionnaire. It is evident from the biographical data that the sample group was well-educated and representative of the different industries and genders.

Table 4.4. Biographical information on sample group (N = 224)

Age Distribution			
	Frequency	Valid %	Cumulative %
20-30 years	150	67%	67%
31-40 years	40	18%	85%
41-50 years	23	10%	95%
50+ years	11	5%	100%
Total:	224	100%	100%
Gender			
Male	106	47%	47%
Female	118	53%	100%
Total:	224	100%	100%
Ethnic Group			
Non-white	92	41%	41%
White	132	59%	100%
Total:	224	100%	100%
Highest Qualification			
Grade 12	144	64%	64%
Diploma	63	28%	92%
Graduate	17	8%	100%

Total:	224	100%	100%
Economic Sector			
Insurance	168	75%	75%
Other	55	25%	100%
Total:	224	100%	100%

4.2.3.1 Initial item analysis

A total of 250 questionnaires were sent out. 226 questionnaires were completed, of which two were spoiled; therefore 224 questionnaires were used for data analysis. The 43 items developed and validated were divided into the following factors. These factors correspond to the most important facets of workload.

- Factor A: Mental Demand
- Factor B: Physical Demand
- Factor C: Temporal Demand
- Factor D: Performance Level
- Factor E: Frustration Level

4.2.3.1.1 Item Statistics

SPSS (version 17.0) was used to conduct item analyses for the initial set of 43 items. All the items were evaluated and items with a total item correlation of ≤0.32 were eliminated from further data analysis. Tables 4.5 to 4.10 indicate the particular item statistics for each of the five initial factors.

Table 4.5. The number of initial items for each factor

Factor	**Number of Items**
Factor A: Mental Demand	9
Factor B: Physical Demand	10
Factor C: Temporal Demand	11
Factor D: Performance Level	6
Factor E: Frustration Level	7

Table 4.6. Item-total statistics – Factor A: Mental Demand

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
A Item 1	31.86	44.075	.757	.903
A Item 2	32.48	43.004	.611	.913
A Item 3	31.57	44.712	.686	.907
A Item 4	31.94	42.220	.732	.903
A Item 5	32.24	42.047	.743	.903
A Item 6	32.16	41.711	.785	.899
A Item 7	32.58	42.899	.716	.904
A Item 8	31.84	44.733	.685	.907
A Item 9	31.94	44.086	.648	.909

This table shows that no items had a total item correlation of ≤ 0.32 (Van der Westhuizen, 2008) and all items were therefore subjected to factor analysis.

Table 4.7. Item-total statistics – Factor B: Physical Demand

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B Item 10	17.98	54.466	.658	.887
B Item 11	17.67	51.745	.763	.879
B Item 12	17.72	54.470	.612	.890
B Item 13	18.03	55.125	.729	.884
B Item 14	17.49	54.027	.556	.894
B Item 15	17.67	51.533	.741	.881
B Item 16	17.96	53.981	.743	.882
B Item 17	17.00	52.430	.563	.896
B Item 18	17.29	54.332	.550	.894
B Item 19	18.25	56.637	.663	.888

This table shows that no items had a total item correlation of ≤ 0.32 and all items were therefore subjected to factor analysis.

Table 4.8. Item-total statistics – Factor C: Temporal Demand

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
C Item 20	**33.89**	**28.530**	**.216**	**.710**
C Item 21	34.24	27.464	.337	.690
C Item 22	34.20	26.502	.378	.684
C Item 23	33.48	26.914	.460	.672
C Item 24	33.26	28.213	.314	.693
C Item 25	**34.38**	**29.044**	**.171**	**.717**
C Item 26	33.31	27.373	.393	.682
C Item 27	33.16	27.687	.437	.678
C Item 28	34.81	26.667	.480	.669
C Item 29	**33.58**	**28.065**	**.280**	**.699**
C Item 30	34.50	25.686	.491	.665

Three items in this scale had a total item correlation of ≤ 0.32. Two of these items were still subjected to factor analysis as literature validated the use of these items in the measurement of workload. Hart and Staveland (1988, p. 241) include temporal demand in their definition of workload and describe this dimension as “the time pressure experienced due to the pace and rate of the task.” The two items were:

- Item 25: I can set my own work pace
- Item 29: My tasks do not place time pressures on me

Item 20 was eliminated and was not used in the factor analysis. It was clear that items 25 and 29 are important contributors to measuring workload and they were therefore included in the factor analysis. With the exception of item 20 all the items were subjected to factor analysis.

Table 4.9. Item-total statistics – Factor D: Performance Level

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
D Item 31	21.16	9.343	.607	.803
D Item 32	20.92	9.280	.726	.775
D Item 33	21.19	9.561	.666	.789
D Item 34	21.20	10.457	.558	.811

D Item 35	21.09	10.148	.607	.802
D Item 36	21.34	10.962	.450	.831

No item had a total item correlation ≤ 0.32 and therefore all items were subjected to factor analysis.

Table 4.10. Item-total statistics – Factor E: Frustration Level

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
E Item 37	15.92	18.011	.476	.706
E Item 38	15.51	15.354	.705	.646
E Item 39	15.33	16.077	.601	.673
E Item 40	15.61	15.252	.723	.641
E Item 41	**16.16**	**22.114**	**.044**	**.782**
E Item 42	16.06	17.584	.524	.695
E Item 43	**16.01**	**20.345**	**.146**	**.780**

Two items had an item-total correlation of ≤ 0.32 and were therefore eliminated from the factor analysis. The two items eliminated were item 41 and item 43. The remaining items had an item-total correlation of ≥ 0.32 and were subjected to factor analysis.

4.2.3.2 Initial descriptive statistics

The description of the statistics is the next step in gaining a basic understanding of data. The table below includes the mean, median, mode, standard deviation, skewness, kurtosis, minimum and maximum for each of the initial dimensions (Factors A – E). The first and most important measure involves the dispersion of the data and includes skewness and kurtosis. Morgan and Griego (1998) state that if if the skewness and/or kurtosis is greater than 2.5 times the standard error the supposition is that normality has been violated. The descriptive statistics for the various factors are included based on Tabacnick and Fidell's (2001) argument that statistics assume that data is normally distributed and it is therefore important to verify the normality of the data.

Table 4.11 Descriptive statistics

		Mental Demand	Physical Demand	Temporal Demand	Performance Level	Frustration Level
N	Valid	224	224	224	224	224
	Missing	0	0	0	0	0
Mean		36.08	19.67	34.31	25.38	21.04
Std. Error of Mean		.492	.542	.252	.249	.320
Median		37.00	18.00	35.00	26.00	21.00
Mode		45	10	35	24	20
Std. Deviation		7.362	8.109	3.764	3.724	4.784
Skewness		-1.344	.833	-.660	-1.178	-.256
Std. Error of Skewness		.163	.163	.163	.163	.163
Kurtosis		2.331	.078	1.243	2.489	-.219
Std. Error of Kurtosis		.324	.324	.324	.324	.324
Minimum		9	10	22	10	9
Maximum		45	48	47	30	32

The following statistics are included in the table above:

- *Valid N (listwise):* This refers to the number of non-missing values.
- *N*: This is the number of valid observations of the variable. The total number of observations is the sum of N and the number of missing values.
- *Minimum:* This is the minimum or smallest number of the variable.
- *Maximum:* This is the maximum or largest number of the variable.
- *Mean:* This is the arithmetic mean across the observations. This is the most generally used measure of central tendency and is frequently referred to as the average.
- *Standard:* The standard deviation is the square root of the variance and measures the distribution of a set of observations. The larger the standard deviation the more distributed the set of observations.
- *Variance:* The variance is a quantification of variability. It is the sum of the squared distances of data value from the mean divided by the variance divisor.
- *Skewness:* Skewness is defined as a measure of the degree and direction of asymmetry. A symmetric distribution has a skewness of 0 and is normally

distributed. A left skewed distribution is negatively skewed and a positively skewed distribution is skewed to the right (UCLA Academic Technology, 2005).

The descriptive statistics indicate a wide spread of values for all the dimensions with values ranging from -1.344 to 2.489 this means that all the values are less than 2.5 times the standard error.

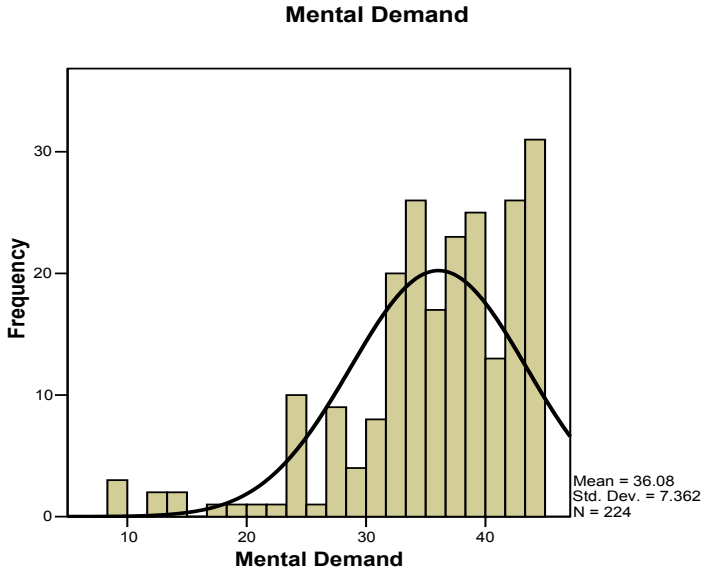

Figure 4.2. Frequency distribution: mental demand

The frequency distribution is negatively skewed and demonstrates a platykurtic distribution.

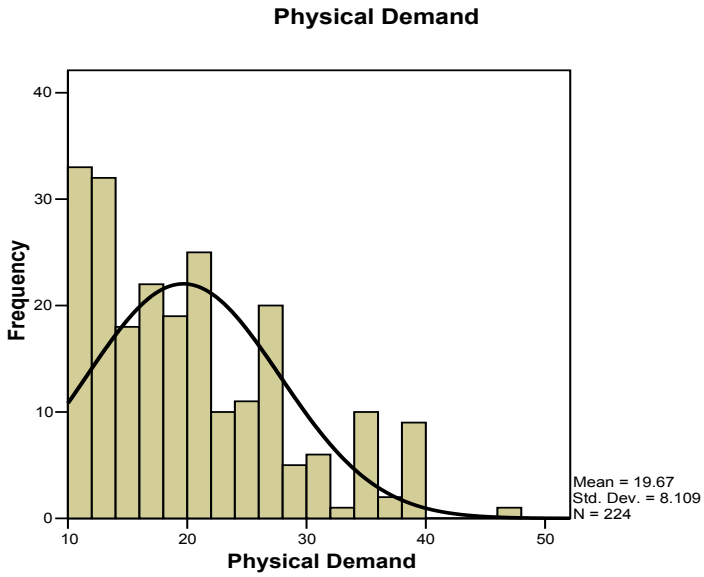

Figure 4.3. Frequency distribution: physical demand

The data for physical demand is positively skewed and is relatively platykurtic in distribution.

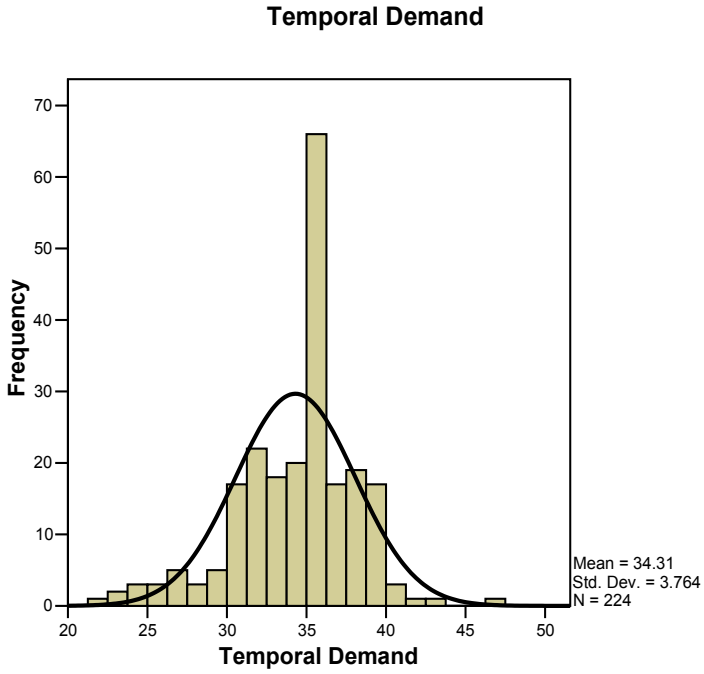

Figure 4.4 Frequency distribution: temporal demand

The data is relatively normally distributed with a leptokurtic distribution.

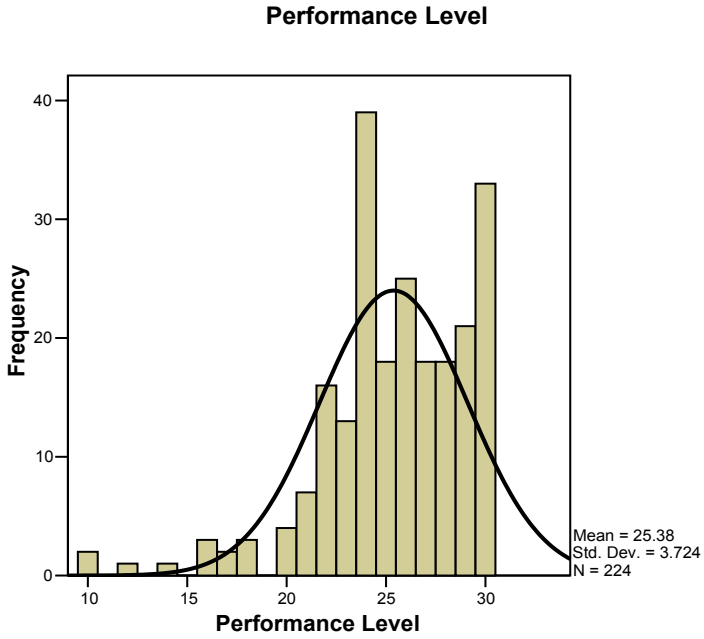

Figure 4.5. Frequency distribution: performance level

The data for the performance level dimension is relatively negatively skewed and illustrates a platykurtic distribution of data.

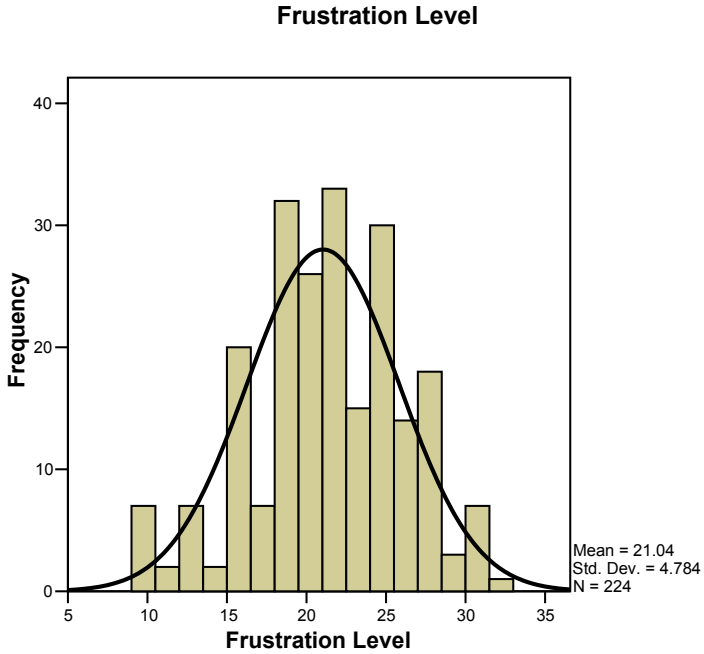

Figure 4.6. Frequency distribution: frustration level

The data appears to be relatively normally distributed with a leptokurtic distribution.

The skewness and kurtosis for each of the different dimensions is satisfactory. Some dimensions are positively skewed while other dimensions are negatively skewed. Two of the dimensions (see figures 4.4 and 4.6) have a relatively normal distribution.

4.2.3.3 Exploratory factor analysis: principle component analysis

A form of exploratory factor analysis referred to as Principle Component Analysis was used for this study. According to Field (2005), Principle Component Analysis establishes the linear component existing within the data and looks at how a specific variable contributes to that component. For example, Principle Component Analysis investigates how Item 1 (I have tasks that require thinking) contributes to Factor A: Mental Demand. Principle Component Analysis was selected as due to its sound psychometric properties (Field, 2005). In the questionnaire the 43 content validated items were clustered beneath the five varying dimensions, each representing a theoretical component of the construct workload. However, based on the item analysis statistics only 40 items were subjected to exploratory factor analysis. The scale was developed with the aim of conducting both an item analysis and an an exploratory factor analysis.

4.2.3.3.1 Kaiser-Meyer-Olkin (KMO) and Barlett's test of sphericity

The KMO statistic forecasts whether the sampling adequacy is likely to factor well, based on correlations and partial correlations (Morgan & Griego, 1998). The variables and the sum of the variables contribute to the overall KMO statistic (Morgan & Griego, 1998). KMO results range from 0.0 to 1.0 and in order to perform a factor analysis the KMO statistic should be 0.7 or more. If a factor analysis is to be performed the Barlett's test should also be significant, meaning a value ≤ 0.05 (Morgan & Griego, 1998).

Table 4.12. KMO and Barlett's test of sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.860
Bartlett's Test of Sphericity	Approx. Chi-Square	5172.799
	Df	780
	Sig.	.000

The KMO result (0.860) showed that the sample size (N = 224) was efficient and the data was appropriate for factor analysis. According to Gorsuch (1983) the result of the KMO should be greater than 0.07 in order to perform exploratory factor analysis. Barlett's test of sphericity indicated a value of .000, which is significant. This means that all the standard deviations are equal with no differences in variance between the items (Van der Linde, 2006).

4.2.3.3.2 Factor Extraction

The following criteria were used to determine the number of factors:

- Keiser's rule of Eigenvalues higher than 1.00;
- Scree Test; and
- A Parallel Analysis.

The factors were selected based on the percentage of variance, the reliability values indicated by Cronbach's Alpha, the results of the Parallel Analysis and the results of the Scree test. The rotated sorted analysis outcome was used to interpret the factor loadings. Variables that had factor loadings ≤ 0.30 were eliminated based on Van der Westhuizen's (2008, p. 148) argument that: "loadings of 0.30 – 0.60 is a moderate loading and loadings between 0.60 – 1.00 is a high loading".

- Eigenvalues

The first step in factor extraction involves computing the linear components within the data set, this step is often referred to as determining the eigenvalues (Field, 2005). The SPSS uses Kaiser's criterion of retaining factors with eigenvalues larger than 1.00. Table 4.13 provides a list of the eigenvalues associated with each factor before and after extraction

(Field, 2005). Before extraction 40 linear components were identified within the SAWS data set. The table also contains information regarding the percentage of variance. It is apparent that the first few factors explain relatively large amounts of variance (e.g. factor 1 explains 22.948% of the total variance). All factors with an eigenvalue of 1.00 were then extracted (Field, 2005), which resulted in nine factors. In the last division of the tables (see table 4.18) the eigenvalues of the factors after rotation are shown. Rotation optimises data (Field, 2005). For example, before rotation factor 1 accounted for more variance than the other factors (22.948%), but after rotation it accounts for 15.937%. Based on the rotation and the eigenvalues a decision was taken to extract six factors.

Table 4.13. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.179	22.948	22.948	9.179	22.948	22.948	6.375	15.937	15.937
2	5.311	13.277	36.226	5.311	13.277	36.226	5.536	13.840	29.777
3	3.978	9.944	46.170	3.978	9.944	46.170	3.612	9.030	38.807
4	2.122	5.304	51.474	2.122	5.304	51.474	3.515	8.787	47.594
5	1.790	4.476	55.949	1.790	4.476	55.949	2.417	6.043	53.636
6	1.489	3.722	59.671	1.489	3.722	59.671	2.414	6.035	59.671
7	1.320	3.299	62.970						
8	1.183	2.957	65.928						
9	1.039	2.599	68.526						
40									

Extraction Method: Principal Component Analysis.

Only factors greater than 1 are displayed.

- The Scree Test

The scree test is a graphic representation of the relative importance of each factor (Field, 2005). As expected the eigenvalues of factors varied greatly. Catell (1966b cited in Field 2005) argues that the cut-off point for choosing factors should be at the elbow of the curve. Further, with a sample group of more than 200 participants (N = 224) the scree plot is a relatively reliable criterion for factor analysis (Field, 2005).

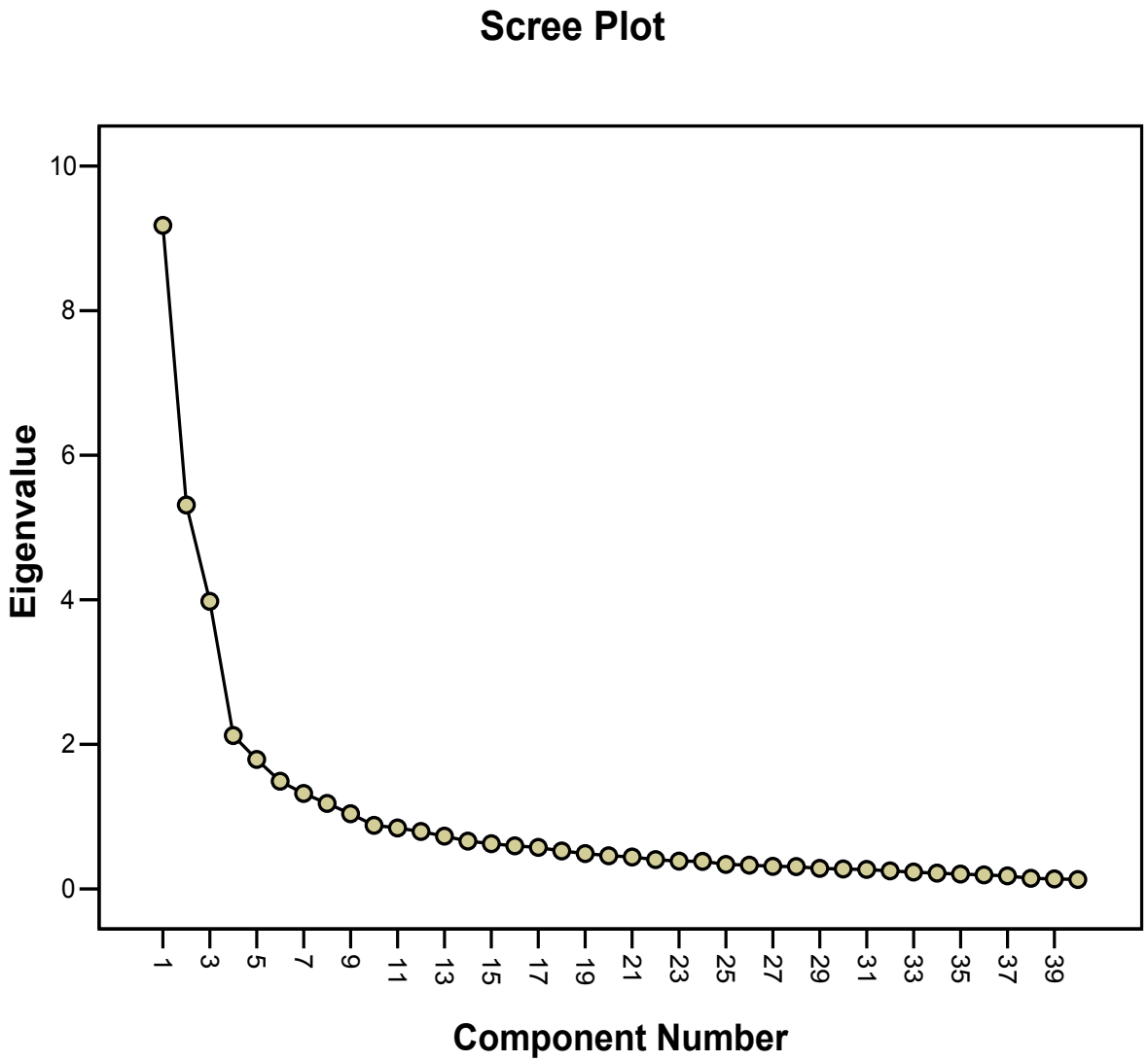

Figure 4.7. Scree Plot

The graph clearly illustrates that the inflexion (elbow) of the curve is at component six. Therefore, based on the scree test six components should be extracted.

- Parallel Analysis

Parallel analysis is based on the premise that nontrivial components from actual data with a valid underlying factor structure should have larger eigenvalues than parallel components from random data having the precise sample size and variables (Hayton, Allen, & Scarpello, 2004). Parallel analysis thus constructs correlation matrices of random

variables with the same number of variables as in the actual sample (N = 224). The average eigenvalues from the random data are then compared to the eigenvalues from the actual data. According to Hayton et al. (2004) factors corresponding to actual eigenvalues that are greater than the random eigenvalues from the parallel analysis should be retained.

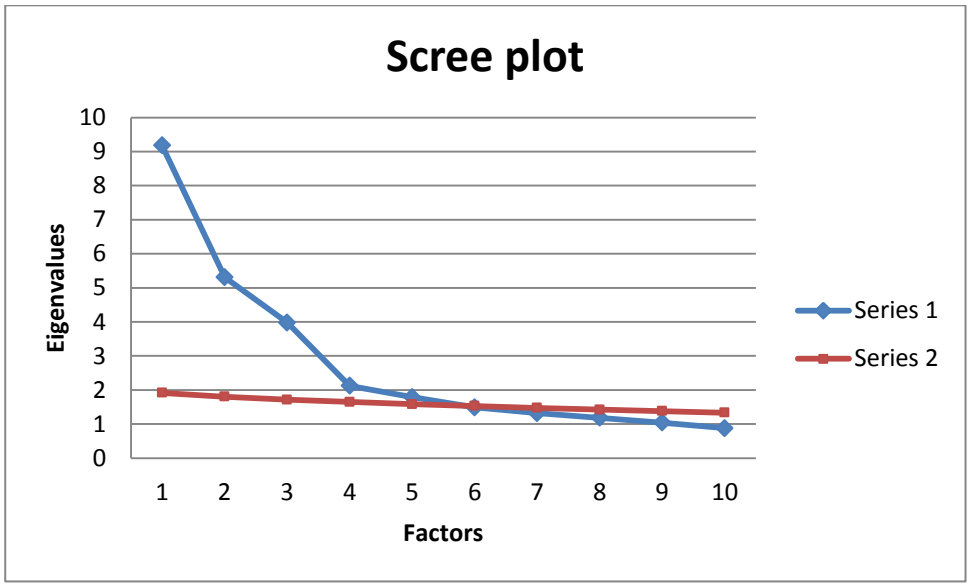

Figure 4.8. Parallel Analysis

Only the first six factors in the real data set (see figure 4.8) have eigenvalues greater than the corresponding eigenvalues generated during parallel analysis from the random data set. Parallel analysis therefore suggests that a six-factor solution is appropriate for the data.

Taking into consideration the total variance explained, the eigenvalues, the parallel analysis and the scree plot six factors were extracted.

4.2.3.3.2 Exploratory Factor Analysis – Orthogonal Rotation (Varimax)

As part of the exploratory factor analysis orthogonal rotation (Varimax) was used. Varimax is the most common method for exploratory factor analysis (Field, 2005). The final part of the factor analysis indicates the rotated component matrix (table 4.14). Table 4.14

illustrates the factor loadings for each variable on each factor. Hair, Anderson, Tatham and Black (1998) provide the following guidelines for evaluating the factor matrix:

- Practical significance and empirical evidence (when the sample size is greater than 100) should be investigated;
- Factor loadings that are greater than 0.30 meet the minimum required level;
- Loadings of 0.40 are more important;
- Loadings that are equal to or greater than 0.50 are considered practically significant; and
- The table's output is sorted by size (p. 384).

Table 4.14. Rotated Component Matrix

	Component					
	1	2	3	4	5	6
A Item 5	**.821**	.008	-.010	.108	-.026	-.044
A Item 1	**.809**	-.007	-.005	.143	.097	.018
A Item 6	**.789**	-.020	.029	.219	.034	.221
A Item 7	**.781**	-.022	.093	.083	.108	.042
A Item 4	**.766**	-.122	.146	.140	-.129	.098
A Item 2	**.705**	-.078	.046	.050	.269	-.181
A Item 8	**.690**	-.046	.012	.265	.019	.205
A Item 9	**.634**	-.081	.077	.258	.028	.139
A Item 3	**.627**	-.187	.170	.397	-.112	.249
B Item 11	-.122	**.825**	-.087	-.016	-.011	.017
B Item 15	-.055	**.816**	.012	.020	-.060	.105
B Item 16	-.076	**.798**	-.088	-.076	-.016	-.165
B Item 13	.018	**.786**	.055	-.037	.090	-.238
B Item 10	-.023	**.712**	-.193	-.102	.015	-.301
B Item 19	-.099	**.702**	-.023	-.062	.111	-.367

B Item 14	-.067	**.669**	.223	.135	-.053	.264
B Item 12	.004	**.663**	-.116	-.143	.085	-.369
B Item 17	.016	**.658**	.022	-.010	.035	.155
B Item 18	-.041	**.644**	.191	-.035	-.023	.266
E Item 38	-.023	-.067	**.824**	.079	.082	.188
E Item 40	.048	-.009	**.822**	.045	.134	.230
E Item 39	.145	-.055	**.747**	.106	.262	.273
E Item 37	.167	.072	**.726**	.038	-.010	-.147
E Item 42	.174	.035	**.686**	-.182	.123	-.195
D Item 33	.266	.015	-.184	**.739**	-.232	-.067
D Item 34	.146	-.038	.039	**.719**	-.239	-.074
D Item 32	.494	-.090	.182	**.657**	-.027	.101
D Item 35	.290	-.083	.034	**.635**	.172	.063
D Item 31	.456	-.120	.267	**.546**	.099	.115
D Item 36	.283	-.019	-.377	**.492**	.098	-.151
C Item 27	.398	.084	.133	.427	**.399**	.098
C Item 26	.390	.002	.090	.414	**.360**	.127
C Item 22	-.048	.139	.062	.028	**.733**	.072
C Item 21	-.017	-.079	.102	-.120	**.726**	.005
C Item 30	.378	.065	.281	.018	**.519**	.030
C Item 28	.162	-.013	.119	-.250	**.486**	.417
C Item 24	.231	-.208	-.090	.045	-.006	**.644**
C Item 23	.282	-.066	.198	.266	.120	**.595**
C Item 25	-.033	.064	.096	-.225	.074	**.401**
C Item 29	.093	-.017	.068	.054	.327	**.396**

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

A Rotation converged in 7 iterations.

Table 4.14 clearly shows that nine variables load highly onto the first factor. These factor items are concerned with ‘mental tasks’. This set of items places emphasis on the mental

demands that the task places on the operator. The second group of variables (ten variables) load onto factor two. All of the loadings are high. Factor two has an underlying theme concerned with ‘physical task challenge’. The next set of variables (five variables) has high loadings on the third factor. Factor three is therefore labelled ‘task frustrations’. The fourth grouping of items consists of six variables with moderate to high loadings. This set of items is focused on ‘performance’. The fifth component has six variables that moderate to high loadings. These variables mainly concern ‘time constraints’, which is the term used to refer to factor five. The last set of four variables has moderate to high loadings on factor six and the theme of this factor is ‘work pace’.

The factor loadings clearly demonstrate that the South African Workload Scale measures the initial dimensions of workload. Performance levels seem to be a facet within mental demand. This finding is logical as achieving performance standards can be a mental task. The findings also suggested that temporal demand consists of two factors: time constraints and work place.

In summary, the content validity ratio established which items to utilise for data collection. A response rate of 224 questionnaires allowed the application of statistical analysis. The descriptive statistics demonstrated that the data was favourably distributed and skewness and kurtosis values were acceptable. All the items demonstrated inter-item correlations. An exploratory factor analysis was carried out using 43 of the initial 71 items. The result of the KMO was .860, indicating that the sample size was satisfactory to proceed with the factor analysis.

The eigenvalues and the inflexion of the curve of the scree plot indicated that six factors should be extracted. The rotated component matrix illustrated that forty items displayed moderate to high loadings. The themes that surfaced were mental tasks, physical task challenge, task frustrations, performance, time constraints and work pace. The study thus concluded that the South African Workload Scale contains 40 items that measure certain dimensions of workload.

The final number of items per factor is presented in table 4.15.

Table 4.15. Items per Factor

Factor	Factor 1: Mental Demand	Factor 2: Physical Demand	Factor 3: Frustration Level	Factor 4: Performance Level	Factor 5: Temporal Demand: Time constraints	Factor 6: Temporal Demand: Work pace
Number of Items	19	10	5	6	6	4
Item Numbers	Items 1, 2, 3, 4, 5, 6, 7, 8, 9.	Items 10, 11, 12, 13, 14, 15, 16, 17, 18, 19.	Items 37, 38, 39, 40, 42.	Items 31, 32, 33, 34, 35, 36.	Items 21, 22, 26, 27, 28, 30.	Items 23, 24, 25, 29.

4.2.3.4 Correlations

In this particular study it was considered important to understand the relationship between the factors and their descriptive items. Field (2005) defines a correlation as a measure of the linear relationship between variables. Pearsons' correlation coefficient is a standardised computation of the relationship between two variables (Field, 2005). For example, the correlation shows the strength of the relationship between factors A (mental demand) and the items generated and tested for mental demand. Pearsons' coefficient results in a value between -1 and +1. A coefficient of +1 indicates that the two variables are perfectly positively correlated and a coefficient of -1 indicates a perfect negative correlation (Field, 2005). Pearsons' correlation coefficient was used because in order for the test statistic to be valid data has to be normally distributed (Field, 2005). The following set of tables (tables 4.16 – 4.20) illustrates the linear relationships.

Table 4.16. Factor A: Mental Demand

		Mental Demand
A Item 1	Pearson Correlation	.808(**)
	Sig. (2-tailed)	.000
	N	224
A Item 2	Pearson Correlation	.709(**)
	Sig. (2-tailed)	.000
	N	224

A Item 3	Pearson Correlation	.751(**)
	Sig. (2-tailed)	.000
	N	224
A Item 4	Pearson Correlation	.799(**)
	Sig. (2-tailed)	.000
	N	224
A Item 5	Pearson Correlation	.808(**)
	Sig. (2-tailed)	.000
	N	224
A Item 6	Pearson Correlation	.840(**)
	Sig. (2-tailed)	.000
	N	224
A Item 7	Pearson Correlation	.784(**)
	Sig. (2-tailed)	.000
	N	224
A Item 8	Pearson Correlation	.749(**)
	Sig. (2-tailed)	.000
	N	224
A Item 9	Pearson Correlation	.727(**)
	Sig. (2-tailed)	.000
	N	224

** Correlation is significant at the 0.01 level (2-tailed).

All the items for Factor A have a strong positive relationship.

Table 4.17. Factor B: Physical Demand

		Physical Demand
B Item 10	Pearson Correlation	.728(**)
	Sig. (2-tailed)	.000
	N	224
B Item 11	Pearson Correlation	.819(**)
	Sig. (2-tailed)	.000
	N	224

B Item 12	Pearson Correlation	.694(**)
	Sig. (2-tailed)	.000
	N	224
B Item 13	Pearson Correlation	.779(**)
	Sig. (2-tailed)	.000
	N	224
B Item 14	Pearson Correlation	.658(**)
	Sig. (2-tailed)	.000
	N	224
B Item 15	Pearson Correlation	.804(**)
	Sig. (2-tailed)	.000
	N	224
B Item 16	Pearson Correlation	.795(**)
	Sig. (2-tailed)	.000
	N	224
B Item 17	Pearson Correlation	.675(**)
	Sig. (2-tailed)	.000
	N	224
B Item 18	Pearson Correlation	.651(**)
	Sig. (2-tailed)	.000
	N	224
B Item 19	Pearson Correlation	.719(**)
	Sig. (2-tailed)	.000
	N	224

** Correlation is significant at the 0.01 level (2-tailed).

All the items for Factor B have a moderate to strong positive relationship.

Table 4.18. Factor C: Temporal Demand

		Temporal_10
C Item 21	Pearson Correlation	.513(**)
	Sig. (2-tailed)	.000
	N	224

C Item 22	Pearson Correlation	.551(**)
	Sig. (2-tailed)	.000
	N	224
C Item 23	Pearson Correlation	.604(**)
	Sig. (2-tailed)	.000
	N	224
C Item 24	Pearson Correlation	.457(**)
	Sig. (2-tailed)	.000
	N	224
C Item 25	Pearson Correlation	.352(**)
	Sig. (2-tailed)	.000
	N	224
C Item 26	Pearson Correlation	.556(**)
	Sig. (2-tailed)	.000
	N	224
C Item 27	Pearson Correlation	.589(**)
	Sig. (2-tailed)	.000
	N	224
C Item 28	Pearson Correlation	.589(**)
	Sig. (2-tailed)	.000
	N	224
C Item 29	Pearson Correlation	.471(**)
	Sig. (2-tailed)	.000
	N	224
C Item 30	Pearson Correlation	.626(**)
	Sig. (2-tailed)	.000
	N	224

** Correlation is significant at the 0.01 level (2-tailed).

All the items for Factor C have a moderate to strong positive relationship.

Table 4.19. Factor D: Performance Level

		Performance

D Item 31	Pearson Correlation	.758(**)
	Sig. (2-tailed)	.000
	N	224
D Item 32	Pearson Correlation	.827(**)
	Sig. (2-tailed)	.000
	N	224
D Item 33	Pearson Correlation	.785(**)
	Sig. (2-tailed)	.000
	N	224
D Item 34	Pearson Correlation	.693(**)
	Sig. (2-tailed)	.000
	N	224
D Item 35	Pearson Correlation	.734(**)
	Sig. (2-tailed)	.000
	N	224
D Item 36	Pearson Correlation	.608(**)
	Sig. (2-tailed)	.000
	N	224

** Correlation is significant at the 0.01 level (2-tailed).

All the items for Factor D indicate a strong positive relationship.

Table 4.20. Factor E: Frustration Level

		Frustration
E Item 37	Pearson Correlation	.717(**)
	Sig. (2-tailed)	.000
	N	224
E Item 38	Pearson Correlation	.840(**)
	Sig. (2-tailed)	.000
	N	224
E Item 39	Pearson Correlation	.842(**)
	Sig. (2-tailed)	.000
	N	224

E Item 40	Pearson Correlation	.868(**)
	Sig. (2-tailed)	.000
	N	224
E Item 42	Pearson Correlation	.696(**)
	Sig. (2-tailed)	.000
	N	224

** Correlation is significant at the 0.01 level (2-tailed).

All the items for Factor E display a strong positive relationship.

The items in the different dimensions all have significant inter-item correlations. This means that the items in each dimension have commonalities and therefore do measure the same construct. In this study the items in the work pace and time constraints' factors were clustered together as the temporal demand component (see table 4.20), because the literature suggested that these items were all related to the temporal demand dimension of workload.

4.2.3.5 Reliability

Cronbach's Alpha measures how well a set of items measure a single construct. The reliabilities for each of the factors as well as the subfactors of Factor: C Temporal Demand are displayed in table 4.21.

Table 4.21. Reliability Statistics (Cronbach's Alpha)

Factor	**Cronbach's Alpha**	**Number of Items**
Factor A: Temporal Demand	.915	9
Factor B: Physical Demand	.898	10
Factor C: Temporal Demand	.710	10
Factor C: Temporal Demand: Time	.697	6

Constraints		
Factor C: Temporal Demand: Work Pace	.470	4
Factor D: Performance Level	.830	6
Factor E: Frustration Level	.855	5

The overall reliability of all the different factors was highly acceptable with Cronbach's Alpha Coefficients ranging between 0.710 and 0.915.

4.2.3.6 Item statistics

SPSS (version 17.0) was used to conduct item analyses for the final set of 40 items. Items were evaluated and items with a total item correlation of ≤0.32 were eliminated from the measurement. Tables 4.22 – 4.26 indicate the particular item statistics for each of the five final factors.

Table 4.22. Item-total statistics – Factor A: Mental Demand

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
A Item 1	31.86	44.075	.757	.903
A Item 2	32.48	43.004	.611	.913
A Item 3	31.57	44.712	.686	.907
A Item 4	31.94	42.220	.732	.903
A Item 5	32.24	42.047	.743	.903
A Item 6	32.16	41.711	.785	.899
A Item 7	32.58	42.899	.716	.904
A Item 8	31.84	44.733	.685	.907
A Item 9	31.94	44.086	.648	.909

This table shows that no item had a total item correlation of ≤ 0.32.

Table 4.23. Item-total statistics – Factor B: Physical Demand

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B Item 10	17.98	54.466	.658	.887
B Item 11	17.67	51.745	.763	.879
B Item 12	17.72	54.470	.612	.890
B Item 13	18.03	55.125	.729	.884
B Item 14	17.49	54.027	.556	.894
B Item 15	17.67	51.533	.741	.881
B Item 16	17.96	53.981	.743	.882
B Item 17	17.00	52.430	.563	.896
B Item 18	17.29	54.332	.550	.894
B Item 19	18.25	56.637	.663	.888

The table shows that no item had a total item correlation of ≤ 0.32.

Table 4.24. Item-total statistics – Factor C: Temporal Demand

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
C Item 21	30.84	23.863	.346	.692
C Item 22	30.81	23.089	.373	.688
C Item 23	30.08	23.343	.473	.672
C Item 24	**29.87**	**24.795**	**.299**	**.699**
C Item 25	**30.99**	**25.592**	**.154**	**.726**
C Item 26	29.92	23.715	.412	.681
C Item 27	29.77	23.919	.470	.675
C Item 28	31.42	23.446	.454	.675
C Item 29	**30.19**	**24.341**	**.297**	**.700**
C Item 30	31.11	22.431	.476	.668

Three items had a total item correlation of ≤ 0.32. These items were subjected to factor analysis as literature has validated the use of these items to measure workload. Hart and Staveland (1988, p. 241) include temporal demand as a dimension of workload and describe it as: “the time pressure experienced due to the pace and rate of the task.” The items do cluster with the Factor: Temporal Demand but may have to be eliminated from the measure.

Table 4.25. Item-total statistics – Factor D: Performance Level

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
D Item 31	21.16	9.343	.607	.803
D Item 32	20.92	9.280	.726	.775
D Item 33	21.19	9.561	.666	.789
D Item 34	21.20	10.457	.558	.811
D Item 35	21.09	10.148	.607	.802
D Item 36	21.34	10.962	.450	.831

The table shows that no items had a total item correlation ≤ 0.32.

Table 4.26. Item-total statistics – Factor E: Frustration Level

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
E Item 37	11.22	14.497	.573	.848
E Item 38	10.81	12.584	.729	.809
E Item 39	10.63	12.494	.729	.808
E Item 40	10.92	12.320	.774	.796
E Item 42	11.37	14.655	.542	.855

The table shows that no items had a total item correlation ≤ 0.32.

4.2.3.7 Descriptive Statistics for the five-factor SAWS

The table below includes each of the final dimensions (Factor A – Factor E) and the two subdimensions of Factor C: Temporal Demand. The mean, median, mode, standard deviation, skewness, kurtosis, minimum and maximum are illustrated for each factor. The most important measures (skewness and kurtosis) involve the dispersion of the data. According to Morgan and Griego (1998), if the skewness and/or kurtosis are greater than 2.5 times the standard error the supposition is that normality has been violated.

Table 4.27. Descriptive statistics

		Mental	Physical	Frustration	Performance	Time_6	Pace_4	Temporal_10
N	Valid	224	224	224	224	224	224	224
	Missing	0	0	0	0	0	0	0
Mean		4.0084	1.9674	2.7473	4.2299	3.2440	3.6060	3.3888
Std. Error of Mean		.05465	.05418	.05986	.04147	.04273	.04213	.03569
Median		4.1111	1.8000	2.8000	4.3333	3.1667	3.5000	3.3000
Mode		5.00	1.00	2.00(a)	4.00	3.17	3.50	3.20
Std. Deviation		.81798	.81095	.89598	.62068	.63956	.63057	.53414
Variance		.669	.658	.803	.385	.409	.398	.285
Skewness		-1.344	.833	.020	-1.178	-.196	.119	.195
Std. Error of Skewness		.163	.163	.163	.163	.163	.163	.163
Kurtosis		2.331	.078	-.469	2.489	1.101	-.471	.435
Std. Error of Kurtosis		.324	.324	.324	.324	.324	.324	.324
Minimum		1.00	1.00	1.00	1.67	1.17	2.00	1.60
Maximum		5.00	4.80	5.00	5.00	4.83	5.00	4.80

The data for the final dimensions indicated a wide spread with values ranging from -1.178 to 2.489. However, all these values were less than 2.5 times the standard error. The data was also checked for outliers and although a few outliers were present the data was sufficiently distributed.

4.3 CONCLUSION

Extensive research was undertaken to determine the facets that constitute workload. The literature shaped the initial design of 73 descriptive items for the South African Workload Scale (SAWS). The draft questionnaire was then checked for relevance using Lawshe's Content Validity technique. The content validity ratio established that a set of 61 items should be used for the pilot study. The reliability statistics for the pilot study determined that some items should be eliminated from the questionnaire and this finding was corroborated by the subject matter experts. Following this phase of the research a total of 43 items remained and were utilised for data collection.

The next phase of the research consisted of testing the South African Workload Scale (SAWS) among employed individuals within two organisations. A response rate of 224 questionnaires allowed the application of statistical analysis. The statistical analyses began with the generation of item statistics and descriptive statistics. The descriptive statistics demonstrated that the data were fairly distributed and skewness and kurtosis values were acceptable. In terms of linear relationships all the different items demonstrated inter-item correlations. Cronbach's Alpha was satisfactory for the initial set of items. However, based on the item statistics three items were eliminated from further research. An exploratory factor analysis was then carried out. The result for the KMO was 0.860 indicating that the sample size was satisfactory.

Various forms of exploratory factor analysis indicated the respective items for each factor. Each factor is defined below.

- *Mental Demand:* The amount of perceptual and mental activity needed for tasks.
- *Physical Demand:* The amount of physical activity needed for tasks.
- *Temporal Demand:* The time pressure experienced due to the pace and rate of the task. This factor can be sub-divided into 'time constraints' and 'work pace'.
- *Performance:* Relates to feelings of success in relation to achievement of the task.
- *Frustration Level:* Includes feelings of annoyance, discouragement, self-doubt, stress, satisfaction, gratification, protection, relaxation and relation in relation to tasks.

This chapter identified the descriptive elements that loaded best on the respective factors in the final South African Workload Scale (SAWS). The analysis indicated that 40 items measure the different facets of workload. A final set of item statistics, total item correlations, reliability analysis and descriptive statistics was computed. The study concluded that certain dimensions of workload are measured by the South African Workload Scale.

CHAPTER 5

Conclusion and Recommendations

"*Success is never final, failure is never fatal. It's courage that counts.*"

John Wooden

5.1 INTRODUCTION

Chapter 4 discussed the application of the analysis methods (item analysis and factor analysis), the interpretation of the data and the reliability and validity of the items. The results confirm the South African Workload Scale's (SAWS) ability to measure sub-dimensions of workload.

This chapter aims to evaluate the research objectives set out in chapter 1. The evaluation is designed to determine whether the research has realised the research objectives and produced satisfactory outcomes.

Although the workload construct has been the subject of much research interest it remains complex and difficult to define. There is no distinct, generally accepted definition of workload but there are several conflicting ideas regarding the component parts of workload. In addition, the term is frequently used without any definition at all. Moray (1979) traces the theoretical development of workload to a NATO conference in 1970 and its text. According to Huey and Wickens (1993) the term workload was not common before the 1970s and numerous academic and non-academic fields disagree about the sources, mechanisms, consequences and measurements of workload. The practical significance of workload was established during the exploration of human-machine systems such as ground transportation, air traffic control and process control. Many studies (Parasuraman & Hancock, 2001) have focused on the theoretical underpinnings, assessment techniques and real-world repercussions of workload in a range of work spheres. This study thus aimed to consider the impact of workload history on the concept of workload in the present time period.

The objective of the research was to determine a definition of workload and understand workload within the South African organisational context.

The primary objective of the research was to develop a workload measure based on the framework established. This objective aimed to:

- Develop a scale that measures all the facets of workload;
- Generate items that measure workload in the South African organisation.

The secondary objective of the study was to enhance the understanding of the concept of workload within South African organisations.

The section below contains information relating to the conclusions reached in regard to these research objectives.

5.2 CONCLUSION ON ANSWERS TO RESEARCH OBJECTIVES

The primary objective of the study was stated as follows:

> *The primary objective is to determine, by means of a comprehensive literature review, what the definition of workload entails and what the meaning of workload constitutes in South African organisations.*

In the literature study (chapter 2) workload was defined in the following contexts:

- *Workload as a function of demand and supply*
  Workload is generally defined as the extent of processing capacity that is expended during the performance of a task. Workload is thus concerned with the interaction between resource supply and task demand (Young et al., 2008) DiDomenico and Nassbaum (2008) agree with this definition and describe workload as determined by the relationship between task demands and the circumstances under which the

takes place and the perceptions, actions, skills and knowledge of the person doing the task.

- *Defining workload as a function of capacity*
  Workload is often defined in terms of its association or interaction with another concept. Workload has been conceptualised in terms of the interaction between the task demands and the capacity of the human operator. O'Donnell and Eggemeier (1986) define workload in terms of the capacity used, with particular reference to the human operator's minimum capacity needed to perform a specific task.

- *Workload defined as an experienced load*
  Workload reflects more than just the demand (external) placed on the human operator. Experienced load shifts the emphasis of workload from task-specific to a more person-specific definition of workload. Experienced load is influenced by factors such as the operator's capabilities, motivation, task strategies and mood (Kruger, 2005).

- *Workload defined in terms of time load*
  Meister (1971) indicates that tasks have to be completed in a certain time and that the human operator only has a certain amount of time available for a particular task. The operator also only has a certain amount of capacity (attention span). The combination of capacity and time available contributes to workload.

Despite the vast amount of information about workload and the diversity of definitions from different paradigms and perspectives no consensus exists in terms of defining workload. For this particular study certain key elements of workload were identified and used as a framework for understanding the different workload factors. These factors were:

- Input load - task demands
- Capacity / resources available
- Operator performance
- Output

A sub-objective of the primary objective was:

Utilising workload definitions in order to compile a comprehensive framework in order to:

- *Develop a scale that measures all the facets of workload;*
- *Generate items that measure workload in South African organisations.*

In order to develop a scale and generate items to measure workload, current measures were analysed. The following measures were discussed extensively in chapter 2 and are the most prominent workload measures currently in use:

- The Modified Cooper-Harper (MC-H) Scale;
- The Bedford Scale;
- The Subjective Workload Assessment Technique (SWAT);
- The NASA Task Load Index (NASA-TLX);
- The Workload Profile (WP).

Each of these scales was evaluated based on set criteria developed in chapter 2. Based on the criteria some elements were considered for constructing items for the workload scale. Once the different subjective measures were analysed the step-by-step scale development process (see chapter 3) proposed by Hinkin (1998) was followed to develop the scale.

A comprehensive framework was compiled that facilitated the compilation of the South African Workload Scale (SAWS). Lawshe's (1975) content validity method was used to determine the subject matter experts' perceptions regarding the workload dimensions and descriptive elements. The results of the content validity method led to 48 of the 71 initial items being included in the questionnaire used in the pilot study (see table 5.2). These items all had a content validity ratio of higher than 0.50. The experts added an additional nine items, which were included in the pilot study. After conducting the pilot study a total of forty-three (43) items were retained for the SAWS.

These phases of instrument development ensured that experts perceived the theoretical construct workload and descriptive elements to be valid and thus acceptable for use in the further development of SAWS.

The last objective of the study aimed:

> *To enhance the understanding of the concept workload and the factors that constitutes the scope of workload within South African organisations.*

The South African Workload Scale was distributed to two organisations with a diverse workforce, as well as to other individuals willing to participate. A response rate of 224 was attained. These 224 individuals were given the opportunity to expand their understanding and awareness of workload.

5.3 CONCLUSIONS REGARDING THE SOUTH AFRICAN WORKLOAD SCALE (SAWS)

The SAWS developed has a five-factor structure and a total of 41 items. This scale was developed through applying the research process described in chapter 3. Statistical procedures such as an item analysis and exploratory factor analysis were used to interpret the 43 items and five factors contained in the original SAWS.

The outcome of the empirical research (see chapter 4) illustrated that the overall reliability of the items in the SAWS is highly satisfactory with Cronbach's Alpha coefficients of 0.915, 0.898, 0.708, 0.803 and 0.741 for the factors. These coefficients are indicative of high reliability.

The results further indicated that the scale is an acceptable, reliable and (to a certain degree) valid workload measure. Five themes surfaced during the factor analysis: performance of mental tasks, physical task challenge, task frustrations, time constraints and work pace.

It can therefore be concluded that the SAWS:

- Is a multi-disciplinary measure of workload that consists of a five-factor scale;
- Is reliable (statistically verified); and
- Has good construct validity in accordance with the perceptions of experts within the applied psychology field.

5.4 LIMITATIONS OF THE PRESENT STUDY

Every research study has limitations that have the potential to impact on the conclusions drawn. A list of possible limitations is presented below:

- The study sample and sample size cannot be generalised and therefore it is now known whether this measure of workload (SAWS) will be a reliable measurement for populations within countries other than South Africa.

- The majority of the sample group of subject matter experts work within the applied psychology field, yet workload relates to expertise from several disciplines.

- The pilot study was conducted with a small convenience sample of individuals working within psychology and a greater and more diverse sample would have been more appropriate.

- The survey was only available in English, one of the eleven official South African languages. It is possible that many participants would prefer to answer the questionnaire in their mother tongue.

- The survey was validated for a very specific sample, with the majority of participants working within the insurance industry.

- The sample size was not sufficient to split the data in order to confirm the factor model.

5.5 CONTRIBUTIONS OF THE PRESENT STUDY

This study has made several contributions:

1) The study developed a holistic workload measurement (SAWS) that measures sub-dimensions of workload.

2) The availability of this measurement tool allows organisations to assess the workload of employees within different departments. Assessing employees' workload will assist the organisation in making adjustments to employees' workload in order to manage their wellness. The organisation will benefit from a healthier, happier workforce.

3) The measure is not tailored for a specific industry or organisation, with the result that the SAWS can be used generically within any organisation.

4) The results of the research enlarged the body of knowledge on workload and serve as a valuable contribution to the theory of workload, specifically from a South African perspective.

5.6 RECOMMENDATIONS FOR FUTURE RESEARCH

The overview of the SAWS and its theoretical foundation suggest that a need for further research as numerous facets of workload is still unexplored. Areas of workload that require further investigation include:

- A workload definition and descriptive elements specific to different industries.

- Each dimension of the current workload measure should be reviewed and expanded to develop a more comprehensive workload measure.

- The human operator states need to be explored in order to construct an all-inclusive workload measure.

- The SAWS should be available in all the eleven official languages of South Africa. Employees will be better able to give a true reflection of their subjective experience of their perception of their workload if they are able to do so in their preferred language.

- A cultural evaluation of South African organisations should be conducted in order to determine whether the SAWS is applicable and appropriate.

- The survey was validated for a very specific sample, with the majority of participants working within the insurance industry. The questionnaire would benefit from being validated within a diversity of industries.

- The expansion of this study to a greater sample will contribute to a greater measure of workload.

- A larger sample size could ensure that the data is split in order to confirm the factor model.

5.7 CLOSING THOUGHTS

This chapter concludes that the research objectives set out in chapter 1 were accomplished. The final scale has acceptable reliability and validity.

In conclusion, human operators have an inadequate ability to mentally and physically process information, store data in memory, make decisions, draw conclusions and execute tasks. These inadequacies can result in the experience of excessive workload, leading to slower task performance and mistakes. However, if human operators experience under load they may become bored, resulting in reduced alertness and concentration.

Workload is linked to competence, working patterns, organisational change (roles and task demands) and human resource supply. Individual human operators experience their workload differently due to different knowledge, skills, training, experience, interest and motivation.

It is therefore essential that a workload measure such as the South African Workload Scale be used to serve the well-being of the most important asset of the organisation, the human operator.

> *"It is not the critic who counts; not the man who points out how the strong man stumbles, or where the doer of deeds could have done them better. The credit belongs to the man who is actually in the arena, whose face is marred by dust and sweat and blood, who strives valiantly; who errs and comes short again and again; because there is not effort without error and shortcomings; but who does actually strive to do the deed; who knows the great enthusiasm, the great devotion, who spends himself in a worthy cause, who at the best knows in the end the triumph of high achievement and who at the worst, if he fails, at least he fails while daring greatly. So that his place shall never be with those cold and timid souls who know neither victory nor defeat".*
>
> **Theodore Roosevelt (1858 – 1919)**

CHAPTER 6

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Faculty of Economic and Management Sciences

ADDENDUM A
Relevance Assessment Questionnaire
Department of Human Resource Management
A WORKLOAD INVENTORY FOR SOUTH AFRICAN ORGANISATIONS

Dear Participant

I am developing an instrument to measure workload in South African organisations. Workload is defined as '*the expenditure incurred by a person, given their capacities (resources), while achieving a particular level of performance on a particular task with certain demands'.*

You are asked to serve as a content expert because of your experience and expertise in industrial psychology, human resources or related fields. Your participation and contribution in the instrument review process is valuable to this study, which is part of a Master's in Industrial Psychology in the Department of Human Resource Management at the University of Pretoria. Your voluntary participation and time spent are highly appreciated.

The instrument consists of items related to different dimensions of workload. Workload will be assessed with a five point rating scale, with 1 representing *Strongly Disagree* and 5 representing *Strongly Agree*, for each item. The different dimensions of workload that will be assessed are as follows:

A. *Mental Demand*

B. *Physical Demand*

C. *Temporal Demand*

D. *Performance*

E. *Effort*

F. *Frustration Level*

On the attached form you are asked to provide some biographic information and to judge the *relevance* and *clarity* of each item related to the specific dimension of workload. You will also be asked to comment on the *comprehensiveness* of the entire instrument and may add or delete items.

Please complete the questionnaire and return it to the researcher. Thank you very much for your time and effort.

Tania Schamrel-Myburgh
E-mail: taniaschamrel@yahoo.com
Tel: 082 467 7781

I provide consent by completing this questionnaire: Yes …….. (tick)

Relevance questionnaire on workload dimensions and associated descriptive elements

Please complete the following questionnaire comprising of 5 pages. There is no right or wrong answer. Judge **each item** honestly, as you perceive it, based on your experience and expertise.

Indicate with an **X** in the relevant block '*not essential'* or '*essential*' to the specific dimension of workload. Indicate with an **X** in the relevant block if the '*item is clear*' or if the '*item is unclear*'. You should have marked 2 **X** at each question.

1. **Relevance**

A. Mental Demand

This part of the questionnaire consists of items related to mental demand. Mental demand is defined as the amount of perceptual and mental activity needed. This includes but is not limited to judgment, deciding and calculating and can be determined by asking whether the task was uncomplicated, challenging, simple or complex, tough or lenient?"

	STATEMENTS	Not essential	Essential	Item is clear	Item is unclear
1	I have tasks that require thinking.				
2	I have to make decisions during task execution.				
3	I am required to make calculations while performing my tasks.				
4	During task execution I am expected to recall information.				
5	I am required to gather information for tasks.				
6	I have to draw conclusions when conducting tasks.				
7	I feel that my tasks are easy.				
8	I am of the opinion that my tasks are simple.				
9	I am of the opinion that my tasks are demanding.				
10	I feel that my tasks are complex.				
11	I have tasks that require the analysis of information.				
12	I am of the opinion that my tasks require prioritising.				
13	My tasks are automated.				
14	I am of the opinion that my tasks require concentration.				
15	I have tasks that necessitate the use of my judgement.				

B. Physical Demand

The Physical Demand Scale addresses the amount of physical activity necessary, which includes pulling, pushing, controlling, regulation and activating.

	STATEMENTS	Not essential	Essential	Item is clear	Item is unclear
16	I have tasks that require physically pushing objects.				
17	My tasks are tough and physically challenging.				
18	During task execution I am expected to physically turn objects.				
19	I am of the opinion tasks require controlling objects.				
20	My tasks necessitate walking.				

21	I have tasks that require moving objects.				
22	I feel that my tasks are physically easy.				
23	I am of the opinion that my tasks are physically difficult.				
24	My tasks require slow bodily actions.				
25	My tasks are physically relaxing.				
26	My tasks are rapid and high-speed actions.				
27	I am of the opinion that my tasks are physically restful.				
28	I am required to use equipment and or machinery during task execution.				
29	I feel physically tired after task execution.				
30	I have tasks that require physically pulling objects.				

C. Temporal Demand

This part of the questionnaire consists of items related to temporal demand which is defined as The time pressure experienced due to the pace and rate of the task.

	STATEMENTS	**Not essential**	**Essential**	**Item is clear**	**Item is unclear**
31	I have tasks that provide for spare time often.				
32	I am of the opinion that my tasks provide for spare time occasionally.				
33	I feel that my tasks almost never make provision for spare time.				
34	My tasks at a rapid pace creating time pressures.				
35	I am confident that my tasks occur at a slow pace.				
36	I feel that my tasks take place at my time.				
37	During task execution, I have to adhere to strict deadlines.				
38	My tasks need to be completed in a certain time.				
39	My task deadlines are flexible.				
40	I am of the opinion that my tasks do not create time pressures.				

D. Performance

This section of the questionnaire consists of performance measures and asks respondents to consider the question: “In terms of goal achievement of the task set by the experimenter or yourself, how successful do you think you were?”

	STATEMENTS	**Not essential**	**Essential**	**Item is clear**	**Item is unclear**
41	I am confident that I achieve my task goals.				
42	I feel that my task completion contribute to the organizations				

	success.				
43	The execution of my tasks demonstrates the mastery of the skills required for my tasks.				
44	I know that I meet job performance standards in all or most tasks.				
45	My work results are inconsistent.				
46	I feel that I do not achieve task goals.				
47	I know that I do not demonstrate the ability to perform my tasks.				
48	I am successful in meeting performance standards.				
49	My tasks are done and completed on schedule.				
50	I am of the opinion that I require a written performance improvement plan.				

E. Effort

The Effort Scale is based on the question: "How hard (mentally and physically) did you have to work to bring about your intensity of performance to achieve goals?"

	STATEMENTS	**Not essential**	**Essential**	**Item is clear**	**Item is unclear**
51	I feel that my tasks require a high level of intensity.				
52	I am of the opinion that I put in a lot of effort to execute tasks.				
53	My tasks are not intense.				
54	During tasks I do not put in any efforts to execute tasks.				
55	I am of the opinion that my tasks require a limited level of intensity.				
56	I put in a little amount of effort to conduct tasks.				

F. Frustration Level

This part of the questionnaire consists of items related to levels of frustration. The core question is: "Did you feel annoyed, discouraged, self-doubting, stressed and annoyed or did you feel satisfied, gratified, protected relaxed and complacent when completing tasks?"

	STATEMENTS	**Not essential**	**Essential**	**Item is clear**	**Item is unclear**
57	I have tasks that make me feel insecure.				
58	My tasks make me feel discouraged.				
59	During task execution I am irritated.				
60	I feel stressed when completing tasks.				
61	My tasks make me feel annoyed.				
62	I have tasks that make me feel secure.				
63	I feel gratified during task				

	execution.				
64	I am of the opinion that my tasks make me feel content.				
65	I am confident that my tasks make me feel relaxed.				
66	My tasks make me feel satisfied.				
67	I have tasks that make me feel competent.				
68	My tasks make me feel incompetent.				
69	My tasks are boring.				
70	I am of the opinion that my tasks are exciting.				
71	I feel helpless during task execution.				

2. Clarity

Workload items should be well written, distinct, and at an appropriate reading level for professional, highly-skilled and skilled individuals employed in various types of organisations (both the private and public sector) from the diverse South African population.

If you have indicated that items are not clear, do you have any suggestions for clarifying items?

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3. Comprehensiveness

Do you think that all the dimensions of the desired content domain of psychological workload have been included in the instrument? Do you have any suggestions for the deletion or inclusion of items?

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4. Biographical information

Please complete the following information. This information is important in order to compile a diverse panel of experts.

1. Age (years) ……

2. Work experience in applied psychology or related field: …….years

3. Gender (indicate with x)

	Male
	Female

4. Ethnic group (indicate with x)

	Black

	Coloured
	Indian
	White

5. Highest qualification (indicate with x and specify field of study)

	Bachelor's degree	
	Honour's degree	
	Master's degree	
	Doctoral degree	

6. Economic sector (indicate with x and specify Industry)

	Primary sector	
	Secondary sector	
	Tertiary sector	
	Government services	
	Other	

Thank you for completing this questionnaire.

Please e-mail to: taniaschamrel@yahoo.com

or

E-mail to: Supervisor Chantal Olckers: chantal.olckers@up.ac.za

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Faculty of Economic and Management Sciences

ADDENDUM B
Informed consent for participation in an academic research study

Department of Human Resource Management

A WORKLOAD INVENTORY FOR SOUTH AFRICAN ORGANISATIONS

Dear Respondent

You are invited to participate in an academic research study conducted by Tania Schamrel-Myburgh, a Master's student from the Department Human Resource Management at the University of Pretoria.

Purpose of the study: To develop an instrument to measure the workload of employees in South African organisations.

Please note the following:

- This study involves an anonymous survey. Your name will not appear on the questionnaire and the answers you give will be treated as strictly confidential.
- Your participation in this study is very important to us. You may, however, choose not to participate and you may also stop participating at any time without any negative consequences.
- Please complete the attached questionnaire as indicated under each of the following five sections: A.) Mental demand B.) Physical demand C.) Temporal demand D.) Performance E.) Effort F.) Frustration level and G.) Biographical information. ALL questions should please be answered in a visible and honest manner. The questionnaire consists of 7 pages. This should not take more than 15 minutes of your time.
- The results of the study will be used for academic purposes only and may be published in an academic journal.
- Please tick the following box to indicate that you give your consent to participate in the study on a voluntary basis. ☐

Research conducted by:

Ms. T.E. Schamrel-Myburgh (24160785)
Cell: 082 467 7781
E-mail: taniaschamrel@yahoo.com

Please rate each statement by indicating your response with an **X.** There are no right or wrong answers.

G. Mental Demand

This part of the questionnaire consists of items related to mental demand, being assessed on a five point rating scale, ranging from 1 = Strongly disagree to 5 = Strongly agree.

	STATEMENTS	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly Agree**
1	I have tasks that require thinking.	1	2	3	4	5
2	I am required to make calculations while performing my tasks.	1	2	3	4	5
3	Remembering information is important in the work that I do.	1	2	3	4	5
4	I am required to collect information for tasks.	1	2	3	4	5
5	I have to draw conclusions in order to carry out my tasks.	1	2	3	4	5
6	My tasks are mentally demanding.	1	2	3	4	5
7	My tasks are complex.	1	2	3	4	5
8	Completing my tasks require concentration.	1	2	3	4	5
9	I have tasks that require me to use my judgement.	1	2	3	4	5

H. Physical Demand

The Physical Demand Scale is also measured on a five-point scale, ranging from 1 = strongly disagree to 5 = strongly agree.

	STATEMENTS	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly Agree**
10	I have tasks that require physically moving large objects.	1	2	3	4	5
11	My tasks are physically challenging.	1	2	3	4	5
12	Running or walking is an important part of my tasks.	1	2	3	4	5
13	My tasks are physically difficult.	1	2	3	4	5
14	My tasks are physically stressful.	1	2	3	4	5
15	My tasks involve fast physical actions.	1	2	3	4	5
16	My tasks are more physical than mental.	1	2	3	4	5
17	My tasks involve making use of equipment.	1	2	3	4	5
18	I feel physically tired after completing my task.	1	2	3	4	5
19	My tasks involve using heavy machinery.	1	2	3	4	5

I. Temporal Demand

This part of the questionnaire consists of items related to temporal demand and is assessed on a five point rating scale, ranging from 1 = Strongly disagree to 5 = Strongly agree.

	STATEMENTS	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
20	I have spare time during working hours.	1	2	3	4	5
21	I work long hours.	1	2	3	4	5
22	I regularly have to work overtime.	1	2	3	4	5
23	My tasks must be performed at a fast pace.	1	2	3	4	5
24	My tasks are carried out at a slow pace.	1	2	3	4	5
25	I can set my own work pace.	1	2	3	4	5
26	My work requires me to adhere to strict deadlines.	1	2	3	4	5
27	My tasks need to be completed within a certain time limit.	1	2	3	4	5
28	I have enough time to complete my tasks.	1	2	3	4	5
29	My tasks do not place time pressures on me.	1	2	3	4	5
30	I have more work than I can do in a day.	1	2	3	4	5

J. Performance

This section of the questionnaire consists of performance related items and is assessed on a five point rating scale, ranging from 1 = Strongly disagree to 5 = Strongly agree.

	STATEMENTS	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
31	My tasks require a high degree of accuracy.	1	2	3	4	5
32	Quality is important in my work.	1	2	3	4	5
33	The performance standards required for my tasks are achievable.	1	2	3	4	5
34	Clear performance standards are set for my tasks.	1	2	3	4	5
35	High performance standards are required for my tasks.	1	2	3	4	5
36	I meet performance standards.	1	2	3	4	5

K. Frustration Level

This part of the questionnaire consists of items related to levels of frustration and is assessed on a five point rating scale, ranging from 1 = Strongly disagree to 5 = Strongly agree.

	STATEMENTS	Strongly	Disagree	Neither agree	Agree	Strongly

		disagree		nor disagree		Agree
37	I have tasks that make me feel unsure of myself.	1	2	3	4	5
38	My tasks cause me to feel irritated.	1	2	3	4	5
39	Carrying out my tasks causes me to feel stressed.	1	2	3	4	5
40	My tasks make me feel frustrated.	1	2	3	4	5
41	My tasks make me feel competent.	1	2	3	4	5
42	I have tasks that cause me to doubt my abilities	1	2	3	4	5
43	I have tasks that make me feel excited.	1	2	3	4	5

L. Biographical information

Please complete the biographical information below.

44. Please indicate your age: _____ years

45. Please indicate your gender

1	2
Male	Female

46. Which ethnic group do you belong to?

1	2	3	4
Black	Coloured	Indian	White

47. Please indicate your highest level of education /qualification

1	2	3	4	5	6
Grade 12	Diploma	Bachelor's degree	Honour's degree	Master's degree	Doctoral degree

48. Indicate the sector in which your organisation operates

1	Financial services
2	Insurance
3	Mining Industry
4	Engineering
5	Government
6	Retail
7	Telecommunications
8	Professional Services
9	Other, please specify……

Thank you for your valuable time and contribution!